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POC: Scott Air Force Base
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FINAL REPORT

OPERATIONAL REQUIREMENTS SUBCOMMITTEE

PRESENTED TO

PUBLIC SAFETY WIRELESS

ADVISORY COMMITTEE

NATIONAL TELECOMMUNICATIONS AND INFORMATION AGENCY

FEDERAL COMMUNICATIONS COMMISSION

As Presented at Scott Air Force Base, IL

May 29, 1996

1.0 EXECUTIVE SUMMARY

This document constitutes the report of the Operational Requirements Subcommittee, Public Safety Wireless Advisory Committee, regarding operational requirements for the public safety communications community nationwide through the year 2010. With respect to each functional area of public safety communications, the report catalogs requirements according to the general nature of the information to be communicated. More technical aspects of each requirement are specified in requirement matrices included as an annex to the basic report. In addition, subcommittee observations and recommendations regarding interoperability issues are noted for such use as the Interoperability Subcommittee may deem appropriate.

2.0 OPERATIONAL REQUIREMENTS SUBCOMMITTEE OVERVIEW

2.1 COMMITTEE OBJECTIVES & ORGANIZATION

The Public Safety Wireless Advisory Committee (the "Advisory Committee") was established in response to provisions of Title VI of the Omnibus Budget Reconciliation Act of 1993 directing that the Federal Communications Commission (FCC) and National Telecommunications and Information Agency (NTIA) coordinate more closely with the public safety community in planning for future spectrum needs.

The general mission of the Advisory Committee is to provide advice and recommendations to the Chairman, FCC and the Administrator, NTIA on operational, technical, and spectrum requirements of federal, state, and local public safety entities through the year 2010.

The Advisory Committee also is to advise the FCC and NTIA of opportunities for improved spectrum utilization and efficiency, facilitate negotiated rule making at the FCC regarding public safety spectrum, and support development and implementation of plans at NTIA regarding federal public safety spectrum

policy.

Based on the assigned mission, the Advisory Committee elected to form five subcommittees. The four subcommittees other than Operational Requirements and their missions are as follows:

The Interoperability Subcommittee is charged with the mission of examining interoperability requirements between and among the various public safety entities, and reducing them to writing. All phases of interoperability, including command and control, are to be examined.

The Technology Subcommittee is charged with the mission of reviewing technology presently implemented, projected technology implementations, and trends in wireless technology. The subcommittee is expected to identify technologies related to each operational need and determine bandwidth required to meet that need. The Technology Subcommittee also is expected to identify spectrum limits for each bandwidth identified.

The Spectrum Subcommittee has the mission of taking the bandwidth and spectrum placement recommendations and recommending a spectrum allocation plan. The plan is expected to include current spectrum assignments and recommendations with regard to future allocations. A timetable is to be developed by the subcommittee based on recommendations received from the Transition Subcommittee.

The Transition Subcommittee has the mission to consider how to implement the new technologies and services in a timely, rational manner. Issues to be considered by this subcommittee include funding methods, migration plans, and time tables.

2.2 CHARTER OF THE OPERATIONAL REQUIREMENTS SUBCOMMITTEE

The general mission of the Operational Requirements Subcommittee (the "Subcommittee") is to enumerate the communication needs of the public safety community without regard to specific technology or spectrum. The needs are to be classified as to the type of service (e.g., realtime, fullmotion video) and quantity of service (number of channels, e.g., two fulltime video channels in every city, one for EMS use and one to be shared between fire and police). Each need additionally is to be prioritized as to necessity for proper functioning of the public safety community.

2.3 SCOPE OF THE SUBCOMMITTEE REPORT

This report of the Subcommittee is intended to provide a snapshot of operational capabilities that must be considered in the overall planning process. The Subcommittee also has examined operational requirements that are unmet or suffer from reliability, quality, or coverage deficiencies. This report of the Subcommittee will be forwarded to the Technology and Interoperability Subcommittees. Requirements for interoperability identified by this Subcommittee will be forwarded to the Interoperability Subcommittee for consideration.

Many public safety entities and organizations provided comment regarding the issues encompassed in the responsibilities of the Subcommittee. In many cases the comments received included topics outside the scope of the Subcommittee charter. The following limitations were observed in preparing this report.

Several comments included specific suggestions regarding the number of channels that should be devoted to particular applications in the commenting agency's particular geographic area of responsibility. The Subcommittee has elected not take a position on issues of spectrum allocation in particular jurisdictions. As a part of its charter, the Subcommittee does have the requirement to provide quantity recommendations of general application, however. Along with other subcommittees, the Operational Requirements Subcommittee therefore provided planning data for use in the quantity model developed with the assistance of engineers from Motorola. Further information regarding this quantity model and the Subcommittee's input is provided at Annex C. In addition, the Subcommittee identified basic quantity recommendations for certain common user lines of communication described in the narrative of the report. Finally, the Subcommittee has in the course of its work attempted to identify the basic complement of communications support that must be maintained by any jurisdiction that provides

the various public safety services involved in this report, along with priorities appropriate to each type of support. The priorities indicated should not be interpreted as indications the public safety community does not consider any indicated requirement essential to maintenance of the public's safety. Every requirement indicated in this report is deemed essential to the public safety mission. Priorities are intended only to indicate the comparative importance of each requirement.

Several comments included specific suggestions regarding the frequency range appropriate for particular requirements. The Subcommittee position is that issues of spectrum use fall within the purview of the Spectrum Requirements and Technology Subcommittees. No recommendations or commentary are included in this report regarding appropriate frequencies.

A few comments were received suggesting that the Subcommittee study and include in its report a catalog of specifications that equipment, for example portable radios, should meet in order to be suitable for public safety use. The Subcommittee considered performing such a study incident to its work, but concluded this topic was not germane to the basic mission of the Subcommittee and the Advisory Committee, which is oriented on spectrum.

3.0 SUBCOMMITTEE ORGANIZATION

3.1 DEFINITION OF PUBLIC SAFETY

At the first meetings of the various subcommittees conducted in Washington, D.C. on September 29, 1995, considerable discussion occurred regarding the definition of "public safety" for purposes of the Advisory Committee. For purposes of this report, the Operational Requirements Subcommittee initially elected to use a very expansive definition, with the understanding that the Advisory Committee might at some future time adopt a less expansive definition for its purposes. The Subcommittee's initial approach was based on two observations. First, the Subcommittee recognized that although a particular constituency's primary business might not fall within a classic public safety definition, aspects of its operations could involve or impact matters of public safety. Second, the Subcommittee recognized that by providing an expansive catalog of requirements from the various constituencies, other subcommittees and ultimately the Advisory Committee would benefit from a broad perspective in determining precisely what requirements should be accommodated when spectrum and other issues are addressed.

Following adoption of definitions of public safety and

related matters, the scope of the Subcommittee report was again discussed, at the Berkeley meeting. At that time, the Subcommittee elected to include in this report and note its support for the definitions adopted by the Advisory Committee which follow:

Public Safety: The public's right, exercised through Federal, State or Local government as prescribed by law, to protect and preserve life, property, and natural resources and to serve the public welfare.

Public Safety Services: Those services rendered by or through Federal, State, or Local government entities in support of public safety duties.

Public Safety Services Provider: Governmental and public entities or those nongovernmental, private organizations, which are properly authorized by the appropriate governmental authority whose primary mission is providing public safety services.

Public Safety Support Provider: Governmental and public entities or those nongovernmental, private organizations which provide essential public services that are properly authorized by the appropriate governmental authority whose mission is to support public safety services. This support may be provided either directly to the public or in support of public safety services providers.

Public Services: Those services provided by nonpublic safety entities that furnish, maintain, and protect the nation's basic infrastructures which are required to promote the public's safety and welfare.

3.2 WORKING GROUPS

The Subcommittee elected to form seven working groups. The working group designations, along with their general areas of focus, are described as follows.

(1) Transport Mechanisms. Initially this working group was designated as the Infrastructure working group. At the Berkeley meeting, its title was changed to Transport Mechanisms to more accurate reflect the scope of its mission. The mission of the Transport Mechanisms working group is to catalog operational requirements for infrastructure communications needed to support other identified public safety communications requirements at federal, state and local levels.

(2) Law Enforcement. The mission of the Law Enforcement working group is to catalog operational requirements for law enforcement organizations at federal, state and local levels.

(3) Emergency Medical Services and Fire Services. The mission of the Emergency Medical Services (EMS) and Fire Services working group is to catalog operational requirements for fire and EMS organizations at federal, state and local levels.

(4) Emergency Management and Disaster Services. The mission of the Emergency Management and Disaster Services (EMD) working group is to catalog operational requirements for emergency management and disaster services at the federal, state and local levels.

(5) Public Service. The mission of the Public Service working group is to catalog operational requirements for public service entities at federal, state and local levels.

(6) Other. The mission of the "Other" working group is to catalog operational requirements for Highway Maintenance, Forestry, General Government, and Mass Transit organizations at federal, state and local levels. At the subcommittee meeting conducted in Berkeley, it was agreed that the Other working group's portion of the report should be separated into areas specific to the organizations involved, i.e. Highway Maintenance, Forestry, General Government and Mass Transit. This separation is reflected in the organization of the final subcommittee report.

(7) Matrix Refinement and Report. The mission of the Matrix Refinement and Report working group initially was development of a common matrix of data required to describe each operational requirement. ~~The matrix developed by the Subcommittee is included with this report as Annex A.~~ As the subcommittee's deliberations continued, it became clear this initial matrix would not be required, and it therefore is not included in this report. This working group also was responsible for preparation of this report.

As the Subcommittee continued its deliberations, it became clear that additional working groups would be required in order to adequately capture the operational requirements of all interested public safety constituencies. Accordingly, working groups for federal, corrections, and intelligent vehicle and highway systems (IVHS) were included in the Subcommittee's deliberations and report.

In addition to the work of the groups described above, the Subcommittee examined quantity and quality aspects of the operational requirements for public safety wireless communications. Quality aspects of these requirements are discussed in Annex A of the report. Quantity aspects of these requirements are reflected in the working group inputs to the planning model adopted by the various subcommittees in order to assist in projecting spectrum requirements. The working group inputs from this Subcommittee are included as Annex B of the report.

3.3 COMMITTEE DELIBERATIONS

An organizational meeting of the Subcommittee was conducted September 29, 1995 in Washington, D.C. At that meeting, discussion was conducted and consensus reached regarding the subcommittee mission and the public safety functional areas to be examined. Consensus also was formed regarding the working groups necessary to accomplish subcommittee purposes. An initial discussion was conducted

regarding the composition of a matrix to be used to catalog each operational requirement identified by the working groups. Following the September meeting, work was completed on a draft version of the matrix.

The subcommittee met again on October 26, 1995 at Camp Dodge, outside Des Moines, Iowa. The principal matter on the agenda was review of the draft matrix. Considerable discussion ensued, resulting in refinement of the matrix for use by the various working groups. Following the October meeting, the matrix was revised to reflect subcommittee deliberations and distributed to working group leaders. Working group leaders began formulating their proposals of operational requirements in each of the functional areas represented by the groups.

A special meeting was conducted in San Bernerdino, California on November 17, 1995. Federal budget issues precluded attendance by a Designated Federal Officer, so the meeting was conducted as an informal review of subcommittee activities and progress. Considerable, wideranging discussion occurred. Attendance was heavily weighted toward users, suggesting that additional meetings in other regions of the United States would benefit the various subcommittees.

A regular meeting of the Subcommittee was conducted in Washington, D.C. on December 13, 1995. Interim reports were presented by the various working group chairs regarding their progress to date. A status report regarding the Subcommittee's activities was presented to the Advisory Committee at its regular meeting conducted December 15, 1995. Following the December 13th meeting, working group leaders continued work on their narratives of operational requirements. Their work was provided the Matrix Refinement & Report working group, which incorporated it in this report.

Additional regular meetings of the Subcommittee were conducted in Berkeley, California on January 10, 1996, Orlando, Florida on February 28, 1996, and San Diego, California on April 11, 1996. Copies of the draft report of the Subcommittee were made available to attendees at each meeting, and comments regarding its content were received. Following each meeting, revisions were made to the report to reflect the consensus of meeting attendees and those who commented by other means.

A regular meeting of the Subcommittee was conducted at Scott Air Force Base, Illinois on May 29, 1996. Copies of the final draft report of the Subcommittee were made available to meeting attendees, and comments regarding its content were received. Following the meeting, revisions were made to reflect consensus of meeting attendees. As revised following this meeting, the report narrative is considered complete. Annexes remained to be completed for quality and quantity considerations, however.

4.0 WORKING GROUP REPORTS

This section of the report of the Subcommittee is a discussion of the operational requirements identified by each working group. In each case, the working group report is intended to present each operational requirement from the user point of view, categorized by the nature of the information to be communicated. Specific, more technical aspects of each requirement identified are reflected in the matrices of operational requirements included at Annex B.

4.1 TRANSPORT MECHANISMS

4.1.1 Mission. The mission of the Transport Mechanisms working group is to catalog operational requirements for communications transport networks and infrastructure at federal, state and local levels.

4.1.2 Introduction. Transport networks consisting of microwave links, satellite links, and leased (copper or fiberoptic) circuits are crucial elements of the infrastructure for routing voice, data and video circuits between communication sites. Wireless links, primarily customer owned microwave networks, have been and will continue to be a primary distribution method for public safety communication systems.

There are also public safety requirements for operational fixed links in the VHF and UHF bands below microwave. Public safety has a definite need for fixed operational links which operate on frequencies

between 70 MHZ and 470 ~~450~~ MHZ. In rural mountainous areas high level sites are frequently ~~generally~~ required to provide wide area system coverage, such as for counties and states. Fixed links are frequently used to give remote base station control. Such links use 72-75 MHz, 150-174 MHz, 406-420 MHz or 450-470 MHz equipment for the link. These links carry signaling and voice to and from the fixed based station. They are necessary because of the unavailability or unreliability of leased control circuits in rural areas. They are also used because they are much more economical than using microwave, and the multi-circuit capability of microwave is not needed. ~~These stations are either of the mobile relay type operating in the VHF 35 to 50 MHZ band, or UHF in the 450 to 460 MHZ band.~~ Often there is no line of site between the dispatch or control point location and the base station to allow microwave control; multiple sites often ~~to allow microwave control and multiple sites~~ cannot be used because of terrain which may be inaccessible or restricted through wilderness designation, or through unavailability of communications site use through federal agency management on federal lands. The only practical and cost effective solution often lies in the use of single ~~link~~ frequencies links which can diffract or bend over the intervening terrain. Seventy MHz is ideal for this purpose, but often a high power 450 MHz link may suffice. In some very remote long distance applications, VHF 150 MHz links may also be used. In some state and county low band systems, VHF high band links are frequently used over very long distances. There is also a second use for these ~~A second requirement is for a~~ lightly loaded, often single channel operational links. They may be ~~These are~~ used for such purposes as voting receiver connectivity or single transmitter control. Microwave links are not suited for these purposes, because of propagation problems, cost and because there is no need for the number of circuits possible with microwave. ~~either because of propagation inadequacy or cost. Further, they are~~ It would be very spectrum inefficient as well to use microwave for such very low density requirements. ~~, as loading is generally very light.~~ Public safety requires dedicated channels for these low density, control purposes. While this use is infrequent, it is highly important where it is needed. ~~Use, while light, is important.~~ Present channels in VHF are heavily shared and very difficult to keep free of interference because of high channel usage when used as links in base and mobile systems. ~~overloaded with nonpublic use.~~ The 450 MHz 12.5 KHz off set links meanwhile have been converted to full power operation by refarming and their use as links will become difficult to impossible. These requirements must be considered in providing for public safety spectrum needs as there is not other viable solution. Where these links are required, there is no commercial service available to use as an alternative because they are for very remote applications.

Customer owned microwave links have proven to be the most reliable transport networks in disaster situations, such as earthquakes and fires. While fiber optic and copper cables are vulnerable to back hoe, fires and earthquakes, microwave links have survived in most disasters. Microwave links and redundantly configured systems, properly engineered to survive disasters, also provide the high reliability required for daytoday public safety operations. ~~Leased land lines frequently suffer outages which public safety systems cannot tolerate.~~ While common carriers can and often do provide valuable services, there are regulatory and economic constraints that restrict their ability to provide reliability and service restoration at the high level required for many public safety applications. Traditional rate-of-return regulation weakens carriers' economic incentives to innovate and to specialize services for specific customers. Any commercial provider is eager to handle public safety traffic in the lucrative metropolitan areas, but they freely admit they will not provide any service to the remote, low density areas. Traditional common carrier regulation limits carriers' incentives to provide high reliability for specific customers.

Commercial leased lines, however, continue to be utilized in many parts of the country for various reasons. For instance, it is often not economically or physically feasible to install microwave links where the circuit requirement is small or there is no path. For a nationwide or statewide link, it may be cost prohibitive to use microwave. When many circuits are required at one location, large savings are generally realized using customer-owned microwave.

Fiber optic links are also extremely useful in numerous transport applications. The cost and practicality of routing fiber optic or copper circuits to remote public safety communications sites (e.g. mountain tops) ~~is~~ can be prohibitive, and as mentioned before not failsafe in case of disasters. Even with high reliability of fiber optics ~~high reliability~~ often alternate routing is required to gain the needed reliability and this ~~which~~ is frequently very difficult to obtain through that medium. Fiber optics costs, however, continue to drop and fiber will be utilized for many applications. Regardless of whether fiber or

microwave is used in high density applications, virtually the same electronic multiplexers are required at each end of the both media. Since electronic devices do occasionally fail, increased reliability is gained through the use of alternate routing. Alternate routing of fiber can be extremely costly because of right of way restraints when feeding multiple sites.

Increasingly, with the advent of Intelligent Transportation Systems (ITS) and other services requiring Dedicated Short Range Communications (DRSC) between infrastructure and public safety vehicles, public safety applications using this technology may occur in much higher frequency ranges as well. These systems may use channels in the microwave range (5.8 GHz) that are being pursued under the ITS program.

4.1.3 Voice Requirements. Just as wireless links are used to transport communications between the roving mobile/portable units and the fixed RF base station sites, wireless infrastructure such as microwave or satellite networks is required to route (analog and/or digital) voice and control messages between the remote RF base station sites and the command/control center. In emergency operation systems, the system operator needs control over the distribution network. As an example, numerous ~~emergency~~ police and fire emergency systems require the use of "multisite simulcasting" to provide wide area coverage with a minimum of frequency resources. Present simulcast systems ~~Simulcast~~ require~~s~~ accurate control over distribution network parameters like delay, levels, and distortion. It is conceivable with future systems on-site timing mechanisms may ease the need for such stable carrier channels, but current systems require them. Private microwave systems allow the system operator precise control over all critical parameters and control over the availability and reliability of the communication paths. The use of leased copper or fiber circuits ~~does not~~ provides less control ~~provide adequate control~~ over all distribution network parameters and over network reliability. This could result in decreased coverage, distorted messages, ~~and~~ communication outages and high maintenance. Private microwave networks are an important ~~imperative~~ requirement for public safety distribution networks.

Many public safety microwave systems also must carry telephone types of traffic. Sometimes this traffic is to connect Public Switched Telephone Network (PSTN) circuits to dispersed offices through agency owned central switching. Other times completely separate systems (separate from the PSTN) are agency provided. The main reason for agency provision of these systems is to assure continued telecommunications ability internal to the agency regardless of either the condition of the PSTN or overload of a distressed PSTN. Often there is also a security (encrypted) aspect of these communications as well which is better maintained through a private network.

4.1.4 Data Requirements. Wireless infrastructure links are frequently also required for transporting public safety data. ~~requirements.~~ Some d~~D~~ata applications include user and equipment status updates, support of mobile/~~digital~~ portable data and computer terminals ~~in vehicles~~, interfaces to numerous databases, geographic position and automatic location devices, computer aided dispatch, biomedical information, remote weather reading for fire management ~~and justice data systems~~ and a myriad of justice and other local and regional data systems.

Many law enforcement agencies have access to their jurisdiction's utility data base so that they have current resident information when they pull up to a specific address. Many public safety agencies also require high security and highly reliable telemetry for supervisory control and data acquisition purposes. Public safety agencies often use hundreds of circuits in voice, data, video, and telemetry applications.

The same kind of strict requirements for voice circuits are even more imperative for data circuit transport. For instance, the tolerances for simulcasting data are even stricter than for voice. Thus, system operator control over the availability, reliability, and technical parameters of the transport network is more critical. Private microwave links are an important ~~imperative~~ requirement for public safety data distribution networks.

4.1.5 Video Requirements. Wireless (microwave and satellite) infrastructure is frequently required for routing video for numerous public safety applications. There are three types of video requirements, full motion, slower limited motion (compressed) and snap shot video.

Full motion wireless systems are required for supporting critical public safety, surveillance operations, field incidents, prison riots, major fires, robotics (i.e., the disarming of a bomb by a robot) and numerous other critical public safety operations. Microwave also ~~will~~ routes ~~the~~ video from the incident location to the command and control center.

Public Safety also requires full motion video for many training video applications because of the fast motion of the subject material. ~~Full motion video is also required in many public safety training video applications because of the fast motion of the subject material.~~ With the current state of the art of digital compression techniques at rates lower than 1.5 Mb/s, compressed video can jerk and smear as the motion of the subject increases in speed. In many police and fire applications this picture distortion can be unacceptable and wideband, full motion video is needed. Microwave can route video from an incident location to a command and control center. Microwave video is also routed between central facilities and outlying facilities for training purposes. Because of the content, this training video is often not suitable for carriage on common carrier networks. Infrared mapping of wildfires from air to ground is another wideband (video) application.

Compressed video circuits are transported on commercial wirelines and on microwave systems, as they require less spectrum than does full motion video. ~~are also transported on microwave systems, and they require less spectrum.~~ Numerous applications such as fingerprints from the vehicle to the command center, video teleconferencing and court arraignment applications can be supported by these types of ~~microwave~~ networks.

4.2 LAW ENFORCEMENT

4.2.1 Mission. The mission of the Law Enforcement working group is to catalog operational requirements for law enforcement organizations at the federal, state and local levels.

4.2.2 Introduction. Wireless communications support is crucial to assure quality law enforcement services and create the safest possible working environment for law enforcement personnel The following discussion is the product of discussion and correspondence with law enforcement officials from various locations in the United States. The emphasis of the working group has been on identification of present and future operational needs, dependent on wireless communication, without regard to cost or the current availability of technology. Needs are categorized into the three basic categories of voice, data and video.

Reducing crime and its impact on the health and welfare of families continues to be a top priority in the United States. In recent years, the most successful anti-crime weapon in the criminal justice arsenal has been implementation of community-based policing in many areas of the country. The heart of this program is getting officers out of cars and into the community, whether it be on foot, bicycle or horseback. Community-based policing programs put an extraordinary demand on communications systems because they require portable coverage throughout the community. Additionally, the 100,000 new officers funded through the Violent Crime Control and Law Enforcement Act of 1994 (Public Law 103-322, commonly called the "Crime Bill") must be community-policing officers. The additional load placed on already overworked communications systems by these new officers has been noticeable.

4.2.3 Voice Requirements. In general, voice communications for law enforcement must include coverage from portable to portable unit, through a system, radio to radio, or some other technology. Officers must be able to speak with each other via the portable radio if they can see each other. Likewise, officers from one end of a jurisdiction must be able to talk to officers in another part of the jurisdiction on a jurisdictionwide path. Voice coverage from portable radios must include the ability to communicate from within buildings with a high degree of reliability.

In particular, t~~T~~he law enforcement voice communications system must be expandable to support a relatively unlimited number of users quickly, i.e., 35 hours. Normal day to day police radio operations may not require high ~~large volume radio~~ capacity. However, when a manmade or natural disaster strikes, the system must have the ability to expand to meet demand.

Voice communications for law enforcement must feature multiple levels of encryption. Routine operational traffic will require one level of encryption. Other operations such as executive protection, high level drug and organized crime unit operations and federal security needs often will warrant a higher level of transmission security. Some routine traffic may be "unencrypted", but devices must be able to monitor both encrypted and nonencrypted messages simultaneously.

Voice Dispatch. Voice communications routinely occur between officers in the field and central dispatch points. Information conveyed commonly includes both operational instructions and information. The law enforcement voice communications system must support routine dispatch communications.

Officer to Officer Voice Communications. Voice communications routinely occur between one officer in the field and one or more other officers in the field. Information conveyed commonly includes both operational instructions, administrative information, and general coordination. The law enforcement voice communications system must provide support for routine voice communications between officers working within a particular jurisdiction.

Air to Ground Voice Communications. Aviation units are a common part of most major law enforcement agencies. Aviation units perform traffic enforcement missions, routine patrol and detection, search and tracking duties, and provide airborne command and control support. Because aviation units commonly work with a separate or distinct group of ground units for a particular operation or event, the law enforcement voice communications system must provide support for routine voice communications between aviation units and officers and commanders on the ground who are working with one or more aircraft. The same path could support air to air communications between aircraft of the employing jurisdiction.

Special Operations Communications. Special investigations, task forces and other discrete activities are a commonplace aspect of today's law enforcement community. A voice communications capability that is separate from normal operations voice traffic is required to support each special operation. These paths must have ~~an extremely high security level of encryption capability available.~~ available the ability to provide highly secure encrypted communications.

Nationwide Travel Channels. A need exists for a nationwide travel channel or channels for use for dignitary protection and emergency units working out of their home area. The channels would be used daily for units traveling across the county for prisoner transport or dignitary protection. The most significant use of these channels would be at events like the National Governors' Conference or during a major disaster like the Oklahoma City bombing, where multiple units from various federal, state and local agencies ~~including federal, state and local~~ detail personnel for a specific incident. The channels must be monitored nationwide and be installed in mobile and portable units nationwide.

4.2.4 Data Requirements. The basic law enforcement requirement for data is immediate, clear transfer and display of text and graphical information for all law enforcement personnel, in support of both routine and emergency operations.

The introduction of NCIC-2000 technology over the next few years will prove to be a force multiplier in the war on crime. For the first time, field officers will be able to positively and rapidly confirm the identity of persons in the field by transmitting a fingerprint to state or federal processing centers. The officer will be able to obtain a photograph of any person who has been cataloged by these systems.

Mobile/Personal Data Computer/Terminal Applications. A need exists for realtime ~~communications~~ support of wireless mobile and portable computer systems capable of transmitting and receiving routine data queries and responses, electronic mail, location data and other graphics including fingerprints and mug shots, along with incidentspecific data and intelligence.

Based on the rapid market penetration of portable two-way radios into law enforcement patrol ranks in the 1970's, the International Association of Chiefs of Police Communications Committee has presented the possibility that over 75% of the nation's patrol force could be equipped with portable data terminals in the 2005-2010 time frame, given that usable equipment and the required infrastructure becomes

available.

Geographic Position and Automatic Location Data. Law enforcement requires the ability to transmit location data, determined by geographic position technology or other means, automatically or on demand to other locations. Examples of this need include constant updating of vehicle positions for dispatch and officer safety purposes, constant updating of individual officer location for safety purposes when the officer is outside his or her vehicle, and the ability to trigger position transmitting devices on lost or stolen equipment items.

Emergency Signals. Officers who need emergency assistance must be able to activate an alarm that sends an automatic distress notice to a central monitoring point and other officers in the field.

Transmission of Reports. This system should accommodate transmission of forms and reports to central sites from mobile and remote locations. This capability will be used ~~by law enforcement~~ to transmit accident~~, reports, arrest reports, citations and incident reports~~ arrest and incident reports, citation information and investigative reports to central locations in long data streams of up to several seconds. This capability will reduce paper transactions, increase officer field time, and speed transmission of vital information to command and administrative staff.

Electronic Messaging. ~~Law enforcement o~~Officers require the ability to input messages into a data transmission device for transmission to single or multiple agencies, including other officers and other public safety providers.

Remote Device Monitoring. Law enforcement requires the ability to monitor remote device indicators via data transmission. For example, the real-time ability to monitor air quality standards at chemical and nuclear incidents is needed ~~on a realtime basis~~ to help establish evacuation plans. Data transmission capabilities must support transmission of wind speed and direction, temperature, and a time and date stamp. The data bank of remote device transmissions must be accessible by remote computer or terminal for incident tracking and decisionsupport by officers in the field including onsite personnel.

Emergency Vehicle Signal Priority. Emergency units when activating lights or siren should emit a signal that is received by traffic control devices along the route of travel to change signal lights and accord the emergency vehicle the right of way. The emergency unit's signal should also be transmitted and received by school buses, mass transit and railroad units (trains) indicating that an emergency vehicle is in the area using emergency equipment. Ultimately, a mapping device should be available that allows rail and mass transit units to see a graphical portrayal of the location and route of emergency vehicles.

4.2.5 Video Requirements. Multiple agencies may need to be able to monitor another agency's video transmissions, but the ability to access public safety video must be based on a "need to know" or incident management control basis.

Incident Video. Some incidents like high risk surveillance, prison riots, high risk drug transactions, and emergencies require realtime video. While these incidents may be infrequent in some areas, others will have a more frequent demand for realtime video. The capability must exist for both pointtopoint and broadcast use of the video. For example, full motion video must be transportable from the incident scene to an incident command post, and also to a remotely located emergency operations center. Prison riots, chemical/nuclear incidents, etc., may require monitoring of the incident from more than one location.

Aerial Surveillance Video. Many law enforcement agencies operate routine surveillance of traffic, crime in progress situations and other events from airborne platforms. Full motion video transmissions from airborne platforms to command and control locations and supervisors on the ground is required.

Robotics Video. Hazardous material and explosive disposal response frequently benefits from use of robotic devices. Full motion video transmissions from the robotic device to a locallylocated control site is required to support such robotics activities.

Surveillance and Monitoring. Law enforcement requires the ability to transmit video snap shots at the

rate of one frame each 5 seconds, for surveillance and monitoring purposes. For example, person and building surveillance, low risk drug transactions, and building security would be adequately served by this quality of video transmission.

Officer Safety and Operational Video Transmission (Two Way). Many patrol cars used by law enforcement agencies now are equipped with mobile video cameras. Video recorded by these cameras provides evidence usable in criminal trials, and documents officer actions in the event professional standards concerns are voiced. The ability to transmit full motion video from mobile video cameras directly to dispatch and other command and control installations is required on demand. Although constant transmission of this data from each individual officer or mobile unit is not required, the ability to monitor video from a unit is needed on an episodic basis in the event of officer assistance situations and other high risk events, or operations of high command interest. In addition, the system must support retransmission of full motion video to mobile and remote locations, where command and control personnel and other mobile officers can monitor, perform decisionmaking and provide assistance based on the video transmission.

StillPhotographs. Law enforcement requires the ability to transmit still photographs on demand to other locations. For example, an officer in the field should be able to transmit a digital image of the violator in custody to a remote location upon demand.

4.3 Fire, Emergency Medical and Related Life and Property

Protection Services.

4.3.1 Mission. The mission of the Fire, Emergency Medical and related Life and Property Protection Services working group is to catalog operational requirements for those public entities that provide services to the public, encompassing emergency life saving and the critical care of the sick and injured, as well as emergency property protection.

Historically these services have been categorized as Fire Service and Emergency Medical Service (EMS), and in many jurisdictions all or part of the functions contained herein are managed exclusively by Fire and EMS providers. For example, the County of Los Angeles Fire Department provides a broad scope of services including fire suppression and prevention, emergency medical paramedic, hazardous materials, urban search and rescue, technical and mountain search and rescue, swift water rescue, and ocean lifeguard services. This broadening scope of service displays significant growth from the historic perspective of fire suppression and first aid. Due in part to this increased responsibility placed upon the public protectors of life and property, we now find many of these services provided by a variety of public safety provider agencies, both as combined service and single service providers.

To reasonably represent all of these providers without regard to umbrella agency categorization, this working group includes a description of the common and unique operational requirements for each of the following life and property protection services:

Fire Suppression and Prevention

Emergency Medical Services

Hazardous Materials

Urban Search and Rescue/ Technical Search and Rescue

Swift Water Rescue

Ocean Lifeguards/ Blue Water Rescue

Other Property Protection and Preservation

4.3.2 Introduction. Wireless command, control and communications support is crucial to assure quality life and property protection and to create the safest possible working environment for Fire, Emergency Medical and related Life and Property Protection services personnel. Wireless technologies are the emerging backbone of command, control, communications, and computerized synthesis of intelligence gathering and distribution (C4I.)

The following material is the product of discussion and correspondence with Fire, Emergency Medical and related Life and Property Protection officials from various locations throughout the United States. The emphasis of the working group has been on identification of present and future operational needs, dependent on wireless communication, without regard to cost or the current availability of technology. Needs are categorized into three basic areas of wireless communication: voice, data, and video.

4.3.3 Fire Suppression and Prevention.

4.3.3.1 Voice Requirements. The basic requirement for voice is immediate, clear voice communications for all fire suppression and prevention personnel upon all demands, major and minor, created by firerelated emergencies. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all incidents. It is not unusual for major incidents to require in excess of 150 separate and distinct voice communication paths to ensure positive, effective incident operations. This large requirement for communication paths is incumbent upon many factors such as, the wide variety of tactical assignments that must be performed simultaneously for rapid containment and control, the need to coordinate between multiple layers of the command structure, the need to coordinate between the incident command structure sections, i.e. operations, logistics, planning, and finance, the need to coordinate with those cooperating agencies that provide support services to the incident, and the need to coordinate with those automatic and mutual aid agencies assisting in fire suppression and prevention activities. These communication paths must be immediately available and expandable to accommodate the rapid change from daytoday operations to major disaster requirements.

4.3.3.1.1 Tactical Voice. Tactical voice communication requirements exist at the actual situation or suppression level of an incident. Tactical assignments vary significantly by location and function. Separate tactical voice paths are required for each strike team, task force, or functional group. The total number of tactical voice paths will vary in accordance with the size and nature of the incident, as well as the number of units required for containment and control. Incidents of magnitude similar to the Old Topanga Incident (1993 Malibu wildland urban interface fire), the 1991 Oakland Hills Fire, or the 1992 Los Angeles civil disturbance fires created tactical voice path demands in excess of 80 distinct tactical paths.

4.3.3.1.2 Command Voice. Command and Control voice communication requirements exist at each successive level of command above the tactical levels. Generally, separate command voice paths will be required for each leader in the chain of command upon which all leaders immediately subordinate will operate. The total number of command voice paths will vary in accordance with the size and nature of the incident. Standard operating procedures for the Incident Command System dictate that a five to one ratio of subordinates to commander is ideal. Large incidents may require in excess of 30 command voice paths.

4.3.3.1.3 Interoperability Voice. The Interoperability subcommittee report examines the need for interoperability voice in detail; however, this communication need must be stressed and catalogued as an operational requirement. Large fire incidents require the aid of a multitude of public safety and public service agencies to effectively save lives and protect property. The Old Topanga Incident (1993 Malibu wildland urban interface fire) called upon the services of 458 assisting agencies from twelve states and in excess of twenty cooperating agencies for containment and control. It is impossible to effect efficient command and control without the ability to communicate with assisting and cooperating agencies on major incidents.

4.3.3.2 Data Requirements. The basic need for data is immediate, clear multiplex wireless transfer and display of data (text and graphics) for all fire personnel upon all demands, major and minor, created by firerelated emergencies. The ability to transmit, receive, and display intelligent data will greatly enhance

and support the overall mission of fire command and control. The advantage of digital text and graphic data in conjunction with voice is accuracy and storage for future recall. Text can be recalled unlimited times to assure correct interpretation of the information. In addition, digital information can be stored and integrated into other data for the purposes of incident reporting and documentation. Data transmission requires less air time than voice, allowing increased availability of voice communication paths.

4.3.3.2.1 Mobile Data Computer / Terminal applications. A need exists for communications support of wireless mobile and portable computer systems capable of transceiving incident specific data and intelligence. Support for these systems should accommodate transmission of text, such as electronic mail, multilayered geographic information data (GIS) as well as real time data, such as automatic vehicle and personnel location, weather and atmospheric conditions, and incident intelligence received from remote sensors or directly keyed.

4.3.3.2.2 Automatic Location Information. A need exists for automatic communication of location information generated to report accurate location of vehicles and personnel into a synthesized computer command and control system. This system should also accommodate associated data, such as emergency situation alert function, personnel vitals and equipment status and needs such as fuel and water. Automatic location information will accomplish several goals in the mission of life and property protection; emergency responders dispatched with regard to actual incident proximity will trim precious life and property saving response times; incident commanders will accurately assign and monitor units/personnel to accomplish strategic efficiency; and fire fighters will report emergency situation location by the push of a button, speeding help their way and reducing the likelihood of injury or death.

4.3.3.2.3 Robotics support. In extremely hazardous situations, fire suppression may only be accomplished with remote suppression equipment supported by robotics. The operation of this equipment will be heavily dependent upon wireless data connectivity.

4.3.3.2.4 Interoperability Data. The Interoperability subcommittee report examines the need for data interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Large fire incidents require the aid of a multitude of public safety and public service agencies to effectively save lives and protect property. Incident intelligence is greatly enhanced by the ability to send and display information formatted as text and graphics. It is impossible to effect efficient command and control without the ability to communicate with assisting and cooperating agencies on major incidents.

4.3.3.3 Video/ Imagery Requirements. The basic requirement for video/ imagery is immediate, clear wireless transfer of video/ imagery for all fire personnel upon all demands, major and minor, created by firerelated emergencies. Video/ imagery capture and display systems must be capable of transceiving incident specific replications and should accommodate video and imagery from all available sources including privately owned and agency controlled. For example, automatic aid agreements with commercial broadcast agencies would often provide quality video/ imagery of incident scenes for command personnel, either directly or through retransmission.

4.3.3.3.1 Incident Video/ Imagery. A need exists for the real time transmission of fire incident scenes from the scene location to the incident command post and also to remotely located emergency operations centers.

4.3.3.3.2 Aerial Observation Video/ Imagery. A need exists for the transmission of video/imagery from airborne platforms to the incident command post.

4.3.3.3.3 Robotics Video/ Imagery. In extremely hazardous situations, fire suppression may only be accomplished with remote suppression equipment supported by robotics. The operation of this equipment will be heavily dependent upon wireless connectivity and the ability to guide these devices via video support.

4.3.3.3.4 Interoperability Video/ Imagery. The Interoperability subcommittee report examines the need

for video/ imagery interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Large fire incidents require the aid of a multitude of public safety and public service agencies to effectively save lives and protect property. Additionally, video and imagery is gathered from multiple sources, both public and private, during major incidents. The ability to utilize video and imagery from multiple sources, as well as the ability to share this information among assisting and cooperating agencies, will greatly enhance incident operations.

4.3.4 Emergency Medical Services, (EMS.)

4.3.4.1 Voice Requirements. The basic requirement for voice is immediate, clear voice communications for all EMS personnel upon all demands, major and minor, created by situations requiring the intervention of EMS personnel. EMS personnel require the ability to communicate by voice with like personnel and units, base station hospitals and doctors, regional transportation coordination centers, airborne medical evacuation resources, fire service and law enforcement resources, infectious disease centers, poison control centers, and many more. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all emergency medical incidents. These communication paths must be immediately available and expandable to accommodate the rapid change from daytoday operations to multi-casualty disaster requirements.

4.3.4.1.1 Patient Care Voice. This voice communication requirement exists at the actual patient care level of an incident. This vital link provides interface between doctors and EMS personnel and fosters proper and efficient treatment for the sick and injured. Separate patient care voice paths are required for each EMS/ hospital team. It is common for multiple EMS units to require immediate interface with the same or multiple base hospitals simultaneously. Seconds, not minutes, make the difference between full recovery, debilitating injury, or death. Rapid, efficient intervention supported by EMS personnel/ base hospital interface plays a critical role in determining the outcome. Numbers of required patient care voice paths will vary in accordance with civilian population and EMS provider area call volume; however, our mobile society transports large numbers of potential victims via highway, rail, and air into sparsely populated areas on a routine basis.

4.3.4.1.2 Scene Control Voice. Scene control voice communication requirements exist at every EMS incident regardless of size or complexity. These voice paths are required to ensure safe working environments, the timely and accurate placement of transportation units, the immediate request for assistance and additional equipment, and overall scene coordination. The required number of scene control voice paths vary with the size and complexity of the incident. A typical multi-casualty incident will require distinct scene control voice paths to support incident command, triage, treatment, and transportation.

4.3.4.1.3 Interoperability Voice. The Interoperability subcommittee report examines the need for interoperability voice in detail; however, this communication need must be stressed and catalogued as an operational requirement. EMS personnel require the ability to communicate by voice with base station hospitals and doctors, regional transportation coordination centers, airborne medical evacuation resources, fire service and law enforcement resources, infectious disease centers, poison control centers, and many more. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all emergency medical incidents.

4.3.4.2 Data Requirements. The basic need for data is immediate, clear multiplex wireless transfer and display of data (text and graphics) for all EMS personnel upon all demands, major and minor, created by EMSrelated emergencies. The ability to transmit, receive, and display intelligent data will greatly enhance and support the overall mission of EMS. The advantage of digital text and graphic data in conjunction with voice is accuracy and storage for future recall. Text can be recalled unlimited times to assure correct interpretation of the information. In addition, digital information can be stored and integrated into other data for the purposes of incident reporting and documentation. Data transmission requires less air time than voice, allowing increased availability of voice communication paths.

4.3.4.2.1 Mobile Data Computer / Terminal applications. A need exists for communications support of wireless mobile and portable computer systems capable of transceiving incident and patient specific data

and intelligence. Support for these systems should accommodate transmission of text such as electronic mail, multilayered geographic information data (GIS), as well as real time data such as automatic vehicle and personnel location.

4.3.4.2.2 Patient Care Data. A need exists for the wireless transfer of patient vitals and diagnostic data. Advanced diagnostic tools such as twelve lead EKG, EEG, ultrasound, and MRI will transfer life saving information between field units and base hospitals.

4.3.4.2.3 Automatic Location Information. A need exists for automatic communication of location information generated to report accurate location of vehicles and personnel into a synthesized computer command and control system. This system should also accommodate associated data such as emergency situation alert function, personnel vitals, and equipment status and needs.

4.3.4.2.4 Interoperability Data. The Interoperability subcommittee report examines the need for data interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. EMS incidents require the aid of a multitude of public safety and public service agencies. Data must be shared to effectively care for the sick and injured.

4.3.4.3 Video/ Imagery Requirements. The basic requirement for video/ imagery is immediate, clear wireless transfer of video/ imagery for all EMS/hospital personnel upon all demands, major and minor, created by EMSrelated emergencies. Video/imagery capture and display systems must be capable of transferring patient specific replications from units in the field to diagnostic patient care centers. The ability for doctors to view the actual patient in conjunction with voice and data assessment information will greatly enhance patient care and survivability.

4.3.4.3.1 Patient Care Video/ Imagery. Video/ imagery capture and display systems must be capable of transferring patient specific replications from units in the field to diagnostic patient care centers. The ability for doctors to view the actual patient in conjunction with voice and data assessment information will greatly enhance patient care and survivability.

4.3.4.3.2 Interoperability Video/ Imagery. The Interoperability subcommittee report examines the need for data interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. EMS incidents require the aid of a multitude of public safety and public service agencies. Video/ Imagery must be shared to effectively care for the sick and injured.

4.3.5 Hazardous Material Teams (Haz Mat.)

4.3.5.1 Voice Requirements. The basic requirement for voice is immediate, clear voice communications for all hazardous materials team personnel upon all demands, major and minor, created by situations requiring the intervention of Haz Mat personnel. Haz Mat personnel require the ability to communicate by voice with a large variety of public safety and public service organizations to effectively contain and safely control hazardous material incidents. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all hazardous materials incidents. These communication paths must be immediately available and expandable to accommodate the rapid changes that occur on incidents of this nature.

4.3.5.1.1 Tactical Voice. Tactical voice communication requirements exist at the actual situation or containment level of an incident. Tactical assignments and functional groups vary significantly on hazardous materials incidents. Haz Mat incidents may be static or dynamic. They may involve fire and explosions. Oceans, lakes, and waterways may be affected; and toxic gas clouds many times complicate the task of containment and civilian safety. Each of these concerns must be addressed and attacked by specialized task groups. Separate tactical voice paths are required for each strike team, task force, or functional group. The total number of tactical voice paths will vary in accordance with the size and nature of the incident, as well as the number and variety of units required for containment and control.

4.3.5.1.2 Command Voice. Command and Control voice communication requirements exist at each successive level of command above the tactical levels. The location and anticipated dynamic

consequence of hazardous material incidents dictate command responsibility. This command responsibility may be placed upon officials from fire agencies, law enforcement, the Coast Guard, Fish and Game, AQMD, etc. Generally, separate command voice paths will be required for each leader in the chain of command upon which all leaders immediately subordinate will operate. The total number of command voice paths will vary in accordance with the size and nature of the incident. Standard operating procedures for the Incident Command System dictate that a five to one ratio of subordinates to commander is ideal. Large incidents require multiple command voice paths. The potential for disaster implied by these incidents dictates that the voice communication conduit from command to subordinate to tactical levels of operation be solid, reliable, and secure.

4.3.5.1.3 Interoperability Voice. The Interoperability subcommittee report examines the need for interoperability voice in detail; however, this communication need must be stressed and catalogued as an operational requirement. Haz Mat personnel require the ability to communicate by voice with a wide variety of assisting and cooperating agencies such as fire, law enforcement, health departments, the Coast Guard, state and federal forestry, fish and game, flood control, AQMD, highways and transportation, toxic substance and poison control centers, agriculture, railroads, Chem. Trek, EMS, utility providers, and state and federal disaster warning centers, etc. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all hazardous material incidents.

4.3.5.2 Data Requirements. The basic need for data is immediate, clear multiplex wireless transfer and display of data (text and graphics) for all Haz Mat personnel upon all demands, major and minor, created by Haz Matrelated emergencies. The ability to transmit, receive, and display intelligent data will greatly enhance and support the overall mission of Haz Mat teams. The advantage of digital text and graphic data in conjunction with voice is accuracy and storage for future recall. Text can be recalled unlimited times to assure correct interpretation of the information. In addition, digital information can be stored and integrated into other data for the purposes of incident reporting and documentation. Data transmission requires less air time than voice, allowing increased availability of voice communication paths.

4.3.5.2.1 Mobile Data Computer / Terminal applications. A need exists for communications support of wireless mobile and portable computer systems capable of transceiving incident specific data and intelligence. Support for these systems should accommodate transmission of text, such as electronic mail, multilayered geographic information data (GIS), as well as real time data, such as automatic vehicle and personnel location, as well as weather and atmospheric conditions.

4.3.5.2.2 Automatic Location Information. A need exists for automatic communication of location information generated to report accurate location of vehicles and personnel into a synthesized computer command and control system. This system should also accommodate associated data such as emergency situation alert function, personnel vitals, and equipment status and needs. Automatic location information will accomplish several goals in the mission of life and property protection: Emergency responders dispatched with regard to actual incident proximity will trim precious life and property saving response times;

incident commanders will accurately assign and monitor units/ personnel to accomplish strategic efficiency; and Haz Mat personnel will report emergency situation location by the push of a button, speeding help their way and reducing the likelihood of injury or death.

4.3.5.2.3 Robotics support. In extremely hazardous situations, hazardous material containment may only be accomplished with remote equipment supported by robotics. The operation of this equipment will be heavily dependent upon wireless data connectivity.

4.3.5.2.4 Interoperability Data. The Interoperability subcommittee report examines the need for data interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Hazardous material incidents require the aid of a multitude of public safety and public service agencies to effectively save lives and protect property. Incident intelligence is greatly enhanced by the ability to send and display information formatted as text and graphics. It is impossible to effect efficient command and control without the ability to communicate with assisting and

cooperating agencies on Haz Mat incidents.

4.3.5.3 Video/ Imagery Requirements. The basic requirement for video/ imagery is immediate, clear wireless transfer of video/ imagery for all Haz Mat personnel upon all demands, major and minor, created by Haz Matrelated emergencies. Video/ imagery capture and display systems must be capable of transceiving incident specific replications and should accommodate video and imagery from all available sources including privately owned and agency controlled. For example, automatic aid agreements with commercial broadcast agencies would often provide quality video/ imagery of incident scenes for command personnel, either directly or through retransmission.

4.3.5.3.1 Incident Video/ Imagery. A need exists for the real time transmission of Haz Mat incident scenes from the scene location to the incident command post and also to remotely located emergency operations centers.

4.3.5.3.2 Aerial Observation Video/ Imagery. A need exists for the transmission of video/imagery and multi-spectral toxic cloud replication from airborne platforms to the incident command post. 4.3.5.3.3 Robotics Video/Imagery. In extremely hazardous situations, hazardous material containment may only be accomplished with remote equipment supported by robotics. The operation of this equipment will be heavily dependent upon wireless connectivity and the ability to guide these devices via video support.

4.3.5.3.4 Interoperability Video/ Imagery. The Interoperability subcommittee report examines the need for video/ imagery interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Hazardous material incidents require the aid of a multitude of public safety and public service agencies to effectively save lives and protect property. Additionally, video and imagery is gathered from multiple sources, both public and private, during major incidents. The ability to utilize video and imagery from multiple sources, as well as the ability to share this information among assisting and cooperating agencies, will greatly enhance incident operations.

4.3.6 Urban Search and Rescue/ Technical Search and Rescue (USAR/ TSAR.)

4.3.6.1 Voice Requirements. The basic requirement for voice is immediate, clear voice communications for all USAR/ TSAR team personnel upon all demands, major and minor, created by situations requiring the intervention of USAR/ TSAR personnel. USAR/ TSAR personnel require the ability to communicate by voice in specialized environments, such as confined spaces created by collapsed structures, trenches, etc., and difficult terrain dictated by steep and broken topography found in mountain and canyon rescues. To effectively conduct operations under these demanding situations, adequate voice communication paths must be provided to foster safety and efficiency. These communication paths must be immediately available and expandable to accommodate the precise coordination required by incidents of this nature.

4.3.6.1.1 Tactical Voice. Tactical voice communication requirements exist at the actual situation or rescue level of an incident. Tactical assignments and functional groups vary significantly on USAR/ TSAR incidents. USAR/ TSAR incidents present rescuers with a variety of exacting operational concerns. Each of these concerns must be addressed and attacked by specialized task groups. Separate tactical voice paths are required for each strike team, task force, or functional group. The total number of tactical voice paths will vary in accordance with the size and nature of the incident, as well as the number and variety of units required to safely effect the rescue.

4.3.6.1.2 Command Voice. Command and Control voice communication requirements exist at each successive level of command above the tactical levels. Generally, separate command voice paths will be required for each leader in the chain of command upon which all leaders immediately subordinate will operate. The total number of command voice paths will vary in accordance with the size and nature of the incident. Standard operating procedures for the Incident Command System dictate that a five to one ratio of subordinates to commander is ideal. Large incidents require multiple command voice paths. Rapid intervention is the key to success on incidents of this nature. Successful operations depend upon immediate voice communications from command to subordinate to tactical levels of operation. This conduit must be solid, reliable, secure and immediately available.

4.3.6.1.3 Interoperability Voice. The Interoperability subcommittee report examines the need for interoperability voice in detail; however, this communication need must be stressed and catalogued as an operational requirement. USAR/ TSAR personnel require the ability to communicate by voice with a wide variety of assisting and cooperating agencies, such as fire, law enforcement, building departments, Haz Mat, public works, flood control, highways and transportation, EMS, utility providers, and engineering entities, etc. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all USAR/TSAR incidents.

4.3.6.2 Data Requirements. The basic need for data is immediate, clear multiplex wireless transfer and display of data (text and graphics) for all USAR/ TSAR personnel upon all demands, major and minor, created by USAR/ TSAR related emergencies. The ability to transmit, receive and display intelligent data will greatly enhance and support the overall mission of USAR/ TSAR teams. The advantage of digital text and graphic data in conjunction with voice is accuracy and storage for future recall. Text can be recalled unlimited times to assure correct interpretation of the information. In addition, digital information can be stored and integrated into other data for the purposes of incident reporting and documentation. Data transmission requires less air time than voice, allowing increased availability of voice communication paths.

4.3.6.2.1 Mobile Data Computer / Terminal applications. A need exists for communications support of wireless mobile and portable computer systems capable of transceiving incident specific data and intelligence. Support for these systems should accommodate transmission of text, such as electronic mail, multilayered geographic information data (GIS), as well as real time data, such as automatic vehicle and personnel location, as well as weather, atmospheric, and seismic conditions.

4.3.6.2.2 Automatic Location Information. A need exists for automatic communication of location information generated to report accurate location of vehicles and personnel into a synthesized computer command and control system. This system should also accommodate associated data, such as emergency situation alert function, personnel vitals, and equipment status and needs. Automatic location information will accomplish several goals in the mission of life and property protection: Emergency responders dispatched with regard to actual incident proximity will trim precious life and property saving response times;

incident commanders will accurately assign and monitor units/personnel to accomplish strategic efficiency; and USAR/TSAR personnel will report emergency situation location by the push of a button, speeding help their way and reducing the likelihood of injury or death.

4.3.6.2.3 Robotics support. In extremely hazardous situations, such as confined space rescues, many tasks may only be accomplished with remote equipment supported by robotics. The operation of this equipment will be heavily dependent upon wireless data connectivity.

4.3.6.2.4 Interoperability Data. The Interoperability subcommittee report examines the need for data interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. USAR/ TSAR incidents require the aid of a multitude of public safety and public service agencies to effectively save lives and protect property. Incident intelligence is greatly enhanced by the ability to send and display information, such as building floor plans formatted as text and graphics. It is impossible to effect efficient command and control without the ability to communicate with assisting and cooperating agencies on USAR/TSAR incidents.

4.3.6.3 Video/ Imagery Requirements. The basic requirement for video/ imagery is immediate, clear wireless transfer of video/ imagery for all USAR/TSAR personnel upon all demands, major and minor, created by USAR/ TSAR related emergencies. Video/ imagery capture and display systems must be capable of transceiving incident specific replications and should accommodate video and imagery from all available sources including privately owned and agency controlled. For example, automatic aid agreements with commercial broadcast agencies would often provide quality video/ imagery of incident scenes for command personnel, either directly or through retransmission.

4.3.6.3.1 Incident Video/Imagery. A need exists for the real time transmission of USAR/ TSAR incident scenes from the scene location to the incident command post and also to remotely located emergency operations centers.

4.3.6.3.2 Aerial Observation Video/ Imagery. A need exists for the transmission of video/imagery, and multi-spectral intelligence from airborne platforms to the incident command post.

4.3.6.3.3 Robotics Video/Imagery. In extremely hazardous situations, rescues may only be accomplished with remote equipment supported by robotics. The operation of this equipment will be heavily dependent upon wireless connectivity and the ability to guide these devices via video support.

4.3.6.3.4 Interoperability Video/ Imagery. The Interoperability subcommittee report examines the need for video/ imagery interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. USAR/ TSAR incidents require the aid of a multitude of public safety agencies and pure communication requirements exist at the actual situation or rescue level of an incident. Tactical assignments and functional groups vary significantly on Swift Water Rescue incidents. Swift Water Rescue incidents present rescuers with a variety of exacting operational concerns over a vast geographic area. Each of these concerns must be addressed and attacked by specialized task groups. Task groups consist of land based resources, watercraft resources, airborne resources, and swimmer insertion teams. Separate tactical voice paths are required for each functional group. The total number of tactical voice paths will vary in accordance with the size and nature of the incident as well as the number and variety of units required to safely effect the rescue.

4.3.7.1.2 Command Voice. Command and Control voice communication requirements exist at each successive level of command above the tactical levels. Generally, separate command voice paths will be required for each leader in the chain of command upon which all leaders immediately subordinate will operate. The total number of command voice paths will vary in accordance with the size and nature of the incident. Standard operating procedures for the Incident Command System dictate that a five to one ratio of subordinates to commander is ideal. Large incidents require multiple command voice paths. Rapid intervention is the key to success on incidents of this nature. Successful operations depend upon immediate voice communications from command to subordinate to tactical levels of operation. This conduit must be solid, reliable, secure and immediately available.

4.3.7.1.3 Interoperability Voice. The Interoperability subcommittee report examines the need for interoperability voice in detail; however, this communication need must be stressed and catalogued as an operational requirement. Swift Water Rescues, as a rule, involve multiple jurisdictions due to the dynamic nature and paths of the involved waterways. Swift Water Rescue personnel require the ability to communicate by voice with a wide variety of assisting and cooperating agencies, such as fire, law enforcement, lifeguards, Coast Guard, public works, flood control, highways and transportation, EMS, etc. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all Swift Water Rescue incidents.

4.3.7.2 Data Requirements. The basic need for data is immediate, clear multiplex wireless transfer and display of data (text and graphics) for all Swift Water Rescue personnel upon all demands, major and minor, created by Swift Water related emergencies. The ability to transmit, receive, and display intelligent data will greatly enhance and support the overall mission of Swift Water Rescue teams. The advantage of digital text and graphic data in conjunction with voice is accuracy and storage for future recall. Text can be recalled unlimited times to assure correct interpretation of the information. In addition, digital information can be stored and integrated into other data for the purposes of incident reporting and documentation. Data transmission requires less air time than voice, allowing increased availability of voice communication paths.

4.3.7.2.1 Mobile Data Computer / Terminal applications. A need exists for communications support of wireless mobile and portable computer systems capable of transceiving incident specific data and intelligence. Support for these systems should accommodate transmission of text such as electronic mail, multilayered geographic information data (GIS), as well as real time data such as automatic vehicle and personnel location, as well as weather and atmospheric conditions.

4.3.7.2.2 Automatic Location Information. A need exists for automatic communication of location information generated to report accurate location of vehicles, personnel, and victims into a synthesized computer command and control system. This system should also accommodate associated data such as emergency situation alert function, personnel vitals, and equipment status and needs. Automatic location information will accomplish several goals in the mission of life and property protection: Emergency responders dispatched with regard to actual incident proximity will trim precious life and property saving response times; incident commanders will accurately assign and monitor units/ personnel to accomplish strategic efficiency; victim location may be accurately tracked to support proper placement of resources; and Swift Water Rescue personnel will report emergency situation location by the push of a button, speeding help their way and reducing the likelihood of injury or death.

4.3.7.2.3 Interoperability Data. The Interoperability subcommittee report examines the need for data interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Swift Water Rescue incidents require the aid of a multitude of public safety and public service agencies over a multi-jurisdictional operational area. It is impossible to effect efficient command and control without the ability to communicate with assisting and cooperating agencies on Swift Water Rescue incidents.

4.3.7.3 Video/ Imagery Requirements. The basic requirement for video/ imagery is immediate, clear wireless transfer of video/ imagery for all Swift Water Rescue personnel upon all demands, major and minor, created by Swift Water Rescuerelated emergencies. Video/ imagery capture and display systems must be capable of transceiving incident specific replications and should accommodate video and imagery from all available sources including privately owned and agency controlled. For example, automatic aid agreements with commercial broadcast agencies would often provide quality video/ imagery of incident scenes for command personnel, either directly or through retransmission.

4.3.7.3.1 Incident Video/ Imagery. A need exists for the real time transmission of Swift Water Rescue incident scenes from the scene location to the incident command post and also to remotely located emergency operations centers.

4.3.7.3.2 Aerial Observation Video/ Imagery. A need exists for the transmission of video/imagery and multi-spectral intelligence from airborne platforms to the incident command post.

4.3.7.3.3 Interoperability Video/ Imagery. The Interoperability subcommittee report examines the need for video/ imagery interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Swift Water Rescue incidents require the aid of a multitude of public safety and public service agencies to effectively save lives. Additionally, video and imagery is gathered from multiple sources, both public and private, during Swift Water Rescue incidents. The ability to utilize video and imagery from multiple sources as well as the ability to share this information among assisting and cooperating agencies will greatly enhance incident operations.

4.3.8 Lifeguards/ Water Safety Personnel.

4.3.8.1 Voice Requirements. The basic requirement for voice is immediate, clear voice communications for all Lifeguards/ Water Safety personnel upon all demands, major and minor, created by situations requiring the intervention of Lifeguards/ Water Safety personnel. Lifeguards/ Water Safety personnel require the ability to communicate by voice in specialized dynamic environments, as well as in routine patrol and rescue situations. To effectively conduct operations under these demanding situations, adequate voice communication paths must be provided to foster safety and efficiency. Paths are required to support beach management, swimmer surveillance, and other routine duties, as well as dynamic demands required in expanded incident situations. These communication paths must be immediately available and expandable.

4.3.8.1.1 Tactical Voice. Tactical voice communication requirements exist at the actual situation or rescue level of an incident. Tactical assignments and functional groups vary significantly on incidents requiring intervention by Lifeguard/ Water Safety personnel. Lifeguard/ Water Safety personnel task

groups consist of landbased resources, watercraft resources, airborne resources, and swimmers. Each of these functional groups and tactical assignments must be addressed and supported by voice communication paths. Clear and distinct tactical voice communication paths must be immediately available for assignment to specific water emergency incidents. Lifeguards/Water Safety personnel handle a multitude of incidents ranging from routine single victim water rescues to multi-casualty incidents, vessel grounding, and downed aircraft. Adequate tactical voice communication paths are required to support multiple incidents simultaneously.

4.3.8.1.2 Command Voice. Command and Control voice communication requirements exist at each successive level of command above the tactical levels. Clear and distinct command voice communication paths must be immediately available and assigned with regard to geographic beach/ water use locations. The quantity of command voice communication paths must be sufficient to support multiple incidents occurring at separate geographic beach/ water use locations simultaneously. This need can be illustrated by examining the jurisdictional area of the County of Los Angeles Fire Department Lifeguards. The County manages 76 miles of coastline on the mainland and the entire coastline of Catalina Island, 28 miles off shore. The mainland shoreline alone is subdivided into 31 separate public beaches. Each beach location requires a clear and distinct command voice path to support rescue operations in that area.

4.3.8.1.3 Interoperability Voice. The Interoperability subcommittee report examines the need for interoperability voice in detail; however, this communication need must be stressed and catalogued as an operational requirement. Lifeguard and water rescue operations often involve multiple jurisdictions and public safety agencies. This shared service posture requires the ability to communicate by voice with a wide variety of assisting and cooperating agencies such as, fire, law enforcement, swift water, Coast Guard, public works, flood control, highways and transportation, EMS, etc. Adequate voice communication paths must be provided for safe, efficient, and effective operations at all Lifeguard/ Water Safety incidents.

4.3.8.2 Data Requirements. The basic need for data is immediate, clear multiplex wireless transfer and display of data (text and graphics) for all Lifeguard/ Water Safety personnel upon all demands, major and minor, created by Waterrelated emergencies. The ability to transmit, receive, and display intelligent data will greatly enhance and support the overall mission of Lifeguard/ Water Safety personnel. The advantage of digital text and graphic data in conjunction with voice is accuracy and storage for future recall. Text can be recalled unlimited times to assure correct interpretation of the information. In addition, digital information can be stored and integrated into other data for the purposes of incident reporting and documentation. Data transmission requires less air time than voice, allowing increased availability of voice communication paths.

4.3.8.2.1 Mobile Data Computer/ Terminal applications. A need exists for communications support of wireless mobile and portable computer systems capable of transceiving incident specific data and intelligence. Support for these systems should accommodate transmission of text such as electronic mail, multilayered geographic information data (GIS), as well as real time data such as automatic vehicle and personnel location, as well as weather and atmospheric conditions.

4.3.8.2.2 Automatic Location Information. A need exists for automatic communication of location information generated to report accurate location of vehicles, personnel, and victims into a synthesized computer command and control system. This system should also accommodate associated data, such as emergency situation alert function, personnel vitals, and equipment status and needs. Automatic location information will accomplish several goals in the mission of life and property protection: Emergency responders dispatched with regard to actual incident proximity will trim precious life and property saving response times; incident commanders will accurately assign and monitor units/ personnel to accomplish strategic efficiency; victim location may be accurately tracked to support proper placement of resources; and Lifeguard/ Water Safety personnel will report emergency situation location by the push of a button, speeding help their way and reducing the likelihood of injury or death. Additionally, search and rescue represents a major responsibility for Lifeguard/ Water Safety personnel. Watercraft in distress or aircraft lost can quickly turn into tragedy if passengers are not rapidly located and rescued. Automatic Location Information can be utilized to establish grid search patterns that will efficiently streamline

search and rescue operations.

4.3.8.2.3 Robotics support. Lifeguards/ Water Safety personnel will utilize the support of robotics devices in underwater search and rescue operations when persons, planes, and ships are submerged in water depths greater than 200 feet. At these depths robotics equipment becomes the preferred method of retrieval. Use of human divers at these depths requires considerable decompression time. The utilization of remote control recovery vehicles eliminates the need to further risk human life to recover a dead body or salvage from ships or planes.

4.3.8.2.4 Interoperability Data. The Interoperability subcommittee report examines the need for data interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Lifeguard/ Water Safety personnel incidents require the aid of a multitude of public safety and public service agencies including the Coast Guard, Harbor Police, local Law enforcement, Fire and EMS agencies. It is impossible to effect efficient command and control without the ability to communicate with assisting and cooperating agencies on water rescue incidents.

4.3.8.3 Video/ Imagery Requirements. The basic requirement for video/ imagery is immediate, clear wireless transfer of video/ imagery for all Lifeguard/ Water Safety personnel upon all demands, major and minor, created by water rescuerelated emergencies. Video/ imagery capture and display systems must be capable of transceiving incident specific replications and should accommodate video and imagery from all available sources including privately owned and agency controlled. For example, automatic aid agreements with commercial broadcast agencies would often provide quality video/ imagery of incident scenes for command personnel, either directly or through retransmission. Remote surveillance of little frequented beaches, underwater inspections of submerged aircraft or vessels, aerial observation of oil spills or major off shore incidents are just a few applications of video/ imagery utilization.

4.3.8.3.1 Incident Video/ Imagery. The ability to transmit clear video/ imagery to the incident commander provides invaluable information for incident management. Large offshore incidents such as cruise ship disasters, aircraft disasters, or oil spills will be greatly enhanced by video/imagery transmission.

4.3.8.3.2 Aerial Observation Video/ Imagery. A need exists for the transmission of video/imagery and multi-spectral interrogation from airborne platforms to the incident command post. This information will greatly assist efforts related to operations such as oil spill management and multiple victim searches created by disasters caused by cruise line or aircraft incidents.

4.3.8.3.3 Robotics Video/ Imagery. Remote and lightlyused beaches are not staffed with daily water safety and lifeguard personnel due to fiscal restraints. Staffing of these water use areas is determined daily by onsite Lifeguard/ Water Safety personnel inspection. Robotics Video/Imagery will allow continuous staffing decisions based on actual real time water use area populations.

4.3.8.3.4 Interoperability Video/ Imagery. The Interoperability subcommittee report examines the need for video/ imagery interoperability in detail; however, this communication need must be stressed and catalogued as an operational requirement. Lifeguard/ Water Safety personnel incidents require the aid of a multitude of public safety and public service agencies to effectively save lives. Additionally, video and imagery is gathered from multiple sources, both public and private, during Water Rescue incidents. The ability to utilize video and imagery from multiple sources, as well as the ability to share this information among assisting and cooperating agencies, will greatly enhance incident operations.

4.4 EMERGENCY MANAGEMENT AND DISASTER SERVICES

4.4.1 Mission. The mission of the Emergency Management and Disaster Services (EMD) working group is to catalog operational requirements for emergency management and disaster services at the federal, state and local levels.

4.4.2 Introduction. Communications system requirements for emergency management and disaster

services are characterized by very low usage patterns during routine operations and extremely high usage patterns during a major event. Thus, radio systems designed and used by emergency management agencies appear to be virtually unused on a daytoday basis, yet when a major event occurs, these same systems are inadequate for meeting the need to communicate. Although individual communications systems performed properly, incident needs still were not met due to interoperability issues in New York at the World Trade Center, in Miami following Hurricane Andrew, in Oklahoma City, in Los Angeles during the Rodney King riots and following the Northridge Earthquake, in San Francisco following the Loma Prieta Earthquake, and countless other times.

We should not look at largescale events as being an anomaly. True, major earthquakes do not occur that often. Nor do hurricanes or floods. Taken all together though, they occur more often than we would like to think. Furthermore, few years pass without a major forest or wildland fire such as those in Yellowstone National Park and in Malibu, California being battled by one thousand or more firefighters from hundreds of fire agencies. Special events such as the Olympics, political conventions, and the "Million Man March" occur each year. The reality is, largescale events happen every year at unpredictable locations and at unpredictable times. Public safety agencies must be prepared to respond to these events when they occur and they need effective communications to aid in their response. While the unpredictability of these events makes it impractical to have adequate wireless communications facilities in place, we can identify and protect a block of frequencies from which such facilities can be rapidly developed. Portable repeaters and programmable multichannel radios have provided the needed technology. It is time for frequency planners to provide the spectrum.

4.4.3 Voice Requirements.

Routine ~~Internal~~ Operations. Emergency management agencies require at least one voice communications path (encryption capable) and one data communications path for command/control of their own personnel during ~~for both~~ routine operations. These same links would be used for a similar function during a disaster or major emergency. ~~and for largescale emergencies and disasters.~~ Agencies having this need include the Federal Emergency Management Agency (FEMA), state disaster control agencies and county disaster control agencies.

Mutual Aid. Largescale emergencies and disasters place a particular burden upon the operation of public safety communications systems. Many of these events exceed the capability of local agencies and they turn to outside agencies to provide mutual aid. While the outside agencies provide the personnel and equipment needed to handle the situation, they also produce an increased demand for communications. A major forest fire, for instance, may involve over one thousand firefighters from over 100 different agencies.

Currently, one channel has been designated nationwide for law enforcement use (155.475 MHz), four channels have been designated nationwide for fire use (45.88 MHz, 154.265 MHz, 154.280 MHz, and 154.295 MHz), and five channels have been designated nationwide for public safety use (866.0125 MHz, 866.5125 MHz, 867.0125 MHz, 867.5125 MHz, and 868.0125 MHz). The Boise Inter-agency Fire Cache (BIFC) provides a resource of equipment which operates on Federal channels which are reserved nationwide for deployment of the BIFC equipment. Some state and local agencies have set aside additional channels to improve the situation, but there remains a dearth of channels to handle a largescale event. This becomes a particular problem in the major metropolitan areas where all other public safety are already in use for normal operations.

Specific recommendations regarding the number of communications paths needed for mutual aid purposes is a subject of the Interoperability Subcommittee report. While those links are desperately needed for mutual aid functions during a disaster or major emergency, to have all of those links remain unused at other times is a misuse of the limited spectrum. Therefore, the Operational Requirements Subcommittee recommends that the mutual aid links be available for use based upon a system of priorities such as the following:

~~A dedicated block of mutual aid channels should be available nationwide for use by any public safety agency. Use of the channels should be subject to a system of priorities such as the following:~~

Priority 1 Disaster and extreme emergency operations for mutual aid and interagency communications

Priority 2 Emergency or urgent operations involving imminent danger to the safety of life or property

Priority 3 Special event control activities, generally of a preplanned nature, and generally involving joint participation of two or more agencies

Priority 4 Single agency secondary communications

It may be desirable to restrict Priority 3 and 4 communications to a particular subset of the set aside mutual aid channels, with different channels available for police, fire, EMS, and other public safety users. While Priority 4 communications do not seem to satisfy the mutual aid requirement, they provide an incentive to public safety agencies to implement the mutual aid capability in their mobile/portable radios.

InterAgency Communications. Many public safety emergencies, particularly largescale emergencies and disasters, require a response from multiple agencies. The response from these agencies needs to be coordinated and controlled. Currently, much of this coordination occurs over the public switched telephone network (PSTN ~~POTS~~). History has shown, however, that the PSTN ~~POTS~~ network is disrupted during a largescale emergency or disaster due to damage or overload. During a major event, at least one voice and one data communications path are needed between each of the following points:

Federal Emergency Management Agency (FEMA) and State Disaster ~~Emergency~~ Services Agency

State Disaster ~~Emergency~~ Services Agency and Event Command Center

Event Command Center and County Government Command Center (provide 10 sets of links (both voice and data) to allow for multiple counties to be involved in the event. ~~For instance,~~ The Loma Prieta Earthquake, for example, affected eight counties). ~~Monterey, Santa Cruz, San Benito, Santa Clara, San Mateo, San Francisco, Alameda, and Contra Costa counties.)~~

County Government Command Center and Major City Command Center (provide 10 sets of links (both voice and data) to allow for multiple counties and cities to establish communications)

The voice links ~~path~~ should be capable of encryption.

Some of these voice and data communications requirements may be satisfied by the long-range communications systems discussed below.

LongRange Communications. Public safety response to largescale emergencies and disasters usually requires the assistance of agencies from outside the "event area." One characteristic of such events, however, is disruption of the normal longrange communication networks through which such assistance might be requested. The public telephone network, for instance, may be unusable due to actual damage resulting from the event or due to system overload. Thus, there is a requirement for longrange communications which either are sufficiently robust as to withstand the initial event or are rapidly deployable.

Highfrequency singlesideband (HFSSB) communications systems are one method by which public safety agencies currently satisfy this requirement. These systems have been established under Section 90.264 of the Federal Communications Commission Rules and Regulations. They operate in the 210 MHz portion of the radio spectrum and offer communications over distances of several hundred miles.

RECOMMENDATION: Maintain the current frequency allocations but eliminate the interstate restrictions on the points of communications. Federal Communications Commission licensing practices on these paths currently restrict use of certain channels to "interstate use only" and, in some cases, to communications with specified other states. These restrictions fail to recognize the usefulness of HF

systems for communications within a large state. The distance between Los Angeles and Sacramento, CA, for instance, is nearly 400 miles. Also eliminate

~~RECOMMENDATION: Eliminate~~ "day/night" restrictions on the use of certain frequencies. The choice of frequency is dependent on many different factors, including not only the timeofday but also the distance between communication points and the propagation conditions. The determination of which frequency is used should be based upon that frequency which provides the needed communications, not the position of the sun.

Satellite based communications are another method by which public safety agencies currently satisfy the requirement. Systems utilizing verysmall aperture (VSAT) technology are capable of providing both voice and data services over virtually any distance.

Urban Search & Rescue. Several Urban Search and Rescue (USART) teams have been established across the country. These teams have proven their value during the Northridge Earthquake and the Oklahoma City bombing through their ability to conduct difficult rescue operations in downed buildings. By their very nature, USART operations are highrisk events where effective communications may affect personnel safety. Currently, the communications for these teams is based upon radio equipment and frequencies used in their home area and are subject to causing/receiving interference with other public safety agencies within the area of the event.

RECOMMENDATION: Set aside communications paths

~~channels~~ on a nationwide basis for ~~specific~~ use by USART personnel. As a minimum, the following is needed:

1 ea repeater pair National USART command channel for communications between the USART team leaders and the event command center.

3 ea repeater pair Team command channel for communications between USART team leaders and members of their team. This is based upon three teams being "onduty" at any given time. Specific channels would be assigned to each team on a "perevent" basis.

10 ea simplex Onscene tactical communications for USART team members. This is based upon different groups working different parts of a building in close proximity, each needing a "clear" channel for safety reasons.

2 ea simplex Robotics control channels. This is based upon two different robotics operations in close proximity.

2 ea simplex Robotics video/audio channels. This is based upon two different robotics operations in close proximity.

The National USART Command channel should be maintained as a clear channel nationwide. The three repeater capable team command channels should be available for local search and rescue operations on the proviso that USART teams have priority access to those channels. Similarly, the simplex tactical and robotics channels should be available for local search and rescue, ski patrol, lifeguard and related activities with the same proviso that USART teams have priority access to those channels in the event of a disaster.

Disaster Medical Assistance. Similar to the USART teams formed by FEMA, the U.S. Public Health Service has formed Disaster Medical Assistance Teams. These DMAT teams provide medical personnel and equipment to handle mass casualties which might result from a major disaster. DMAT teams need to exchange information regarding the numbers and types of casualties, the availability of resources, and requests for additional resources.

RECOMMENDATION: Set aside communications paths on a nation-wide basis for use by DMAT

teams. As a minimum, the following is needed:

1 ea repeater pair National DMAT command channel for communications between the DMAT team leaders and the event command center.

1 ea data channel National DMAT data channel for communications between DMAT teams and the event command center.

Damage Assessment and Infrastructure Repair. Immediately following a major disaster such as an earthquake, floor or hurricane, the amount of damage needs to be inventoried. From this inventory, damage to critical infrastructure such as roads, water works and utilities can be identified, prioritize and repaired.

RECOMMENDATION: Establish one voice and data communications path nationwide for each of the following infrastructure services. In each case, private utility and governmental disaster services agencies should be eligible to use the link for purposes of exchanging information regarding damage/repair.

Electric power providers

Natural gas distributors

Water providers

Road agencies

The Operational Requirements Subcommittee recognizes that each of these infrastructure services have requirements for radio spectrum to support their disaster response. Although the committee supports these requirements, discussion of the requirements and the spectrum requirements are not within the scope of the PSWAC report.

Non-Public Safety Agency Communications. ~~NonPublic Safety Agencies.~~ Many nonpublic safety agencies provide valuable services during a disaster or major emergency. These agencies include the American Red Cross, the Salvation Army, ~~and~~ the Civil Air Patrol and the National Guard. Public officials managing the disaster or event need voice and data communications with these agencies to exchange information regarding the care and feeding of victims.

RECOMMENDATION: Establish 5 ~~10~~ nationwide voice/data channels for communications between event command centers and these agencies. Eligibility for use of these channels should include the American Red Cross, the Salvation Army, Civil Air Patrol and National Guard and other non-public safety agencies providing similar disaster relief functions.

These agencies also have a need for communications internal to their operations during the disaster. Although these needs are not a subject of this report, the Operational Requirements Subcommittee recognizes these needs and supports providing radio spectrum for these functions. Communications requirements include internal operation of a shelter to provide security, food, water, clothing, bedding and other supplies.

News Media & Emergency Broadcast. Public officials managing any event have an obligation to inform the public about the emergency. The Emergency Broadcast System and the news media provide a valuable means by which information can be distributed to the public. A weak link in the system, however, is the link between the public official and the media. Currently, these messages are passed to the media either at a news conference or via telephone calls.

The State of California has implemented a system called the Emergency Digital Information System (EDIS) which utilizes landmobile radio channels to pass digital messages directly to commercial broadcasters. These messages are formatted such that radio/TV announcers can "rip and read" as if the

message were a teletype message and TV broadcasters can scroll the message across the screen. Messages can be generated by any public official ~~having access to the system with the Governor's Office of Emergency Services controlling use of the system~~.

RECOMMENDATION: Establish a nationwide communications path ~~channel~~ for EDIStype messages from appropriate public officials to broadcasters.

RACES. Radio Amateur Civil Emergency Service (RACES) operates on radio amateur frequencies by authority of the Federal Communications Commission in support of public safety. RACES can augment existing systems, substitute for damaged and inoperable systems, and establish communications links with otherwise inaccessible areas. RACES uses HF, VHF, and UHF equipment operating on packet (data), voice, CW Morse code, radioteletype, and television (ATV). While not a public safety spectrum requirement, the services provided through RACES should be continued and protected.

4.4.5 Data Requirements.

Global Positioning. While not a spectrum requirement, access to the Global Positioning System (GPS) is a valuable tool in a disaster. Following an earthquake, flood, hurricane, or other disaster it is not uncommon for normal landmarks to have disappeared. Buildings are destroyed, streets are covered, and road signs are missing. Emergency management personnel need a means by which they can map the event so that they can better understand where the problems lie and dispatch personnel to deal with situations appropriately.

4.5 PUBLIC SERVICE

4.5.1 Mission. The mission of the Public Service working group is to catalog operational requirements for public service entities at the federal, state and local levels.

4.5.2 Introduction. One classification of public safety wireless communication users are those entities that rely on wireless systems to prevent catastrophes which endanger life and property. Entities such as transportation companies and public utilities operate communications networks that interface with local, state and federal public safety entities on a daily basis. One primary purpose of these networks is to minimize risk to the public. These networks also aid other public safety providers in performing their missions when a catastrophe does occur. This section of the report briefly identifies many of the current communications requirements of this class of wireless communication users. A more detailed description of these requirements can be found in Appendix C.

4.5.3 Voice Requirements.

Dispatcher to Crews. This is a typical communications path between dispatchers and field personnel. The call types are typically business oriented with emphasis on operating the business in a safe and efficient manner.

Crew to Crew. This function relates to the typical communications between field users. These communications are used for the coordination of daily activities to maximize the safety and efficiency of operations.

Emergency Call. This function is typically initiated from a field user to a dispatcher. As the name implies, the call type is that of an emergency where loss of life or property is imminent or has already taken place.

"Talk Around". In many operations between field users, routing a call through the network or a repeater is not feasible for reasons such as access delay or being out of range of the system. A talk around mode is necessary so that the field users can communicate with each other, within the range of their mobiles and portables, without the assistance of a network or repeater.

Interconnect. In nearly all field activities, users have a need to communicate with people by way of land

line telephones. Telephone interconnect is a necessary option for many of the present day radio systems.

4.5.4 Data Requirements. The Public Services entities have a substantial need for data communications which is typically very specific for each type of entity. As an example, the railroad industry relies on data communication links to assist the engineer in safe train handling as well as providing early notification of track or equipment malfunctions. The railroads also utilize data communication links to assist in the prevention of collisions between two trains as well as between trains and other types of vehicles.

The Utility industry relies on data communication systems for the purposes of controlling electrical distribution systems and pipelines which include gas, steam, and water. Electrical distribution systems utilize these data links to trip circuit breakers in the event of a power fault or short circuit. They also utilize these systems to control the amount of load which the generation facilities have to serve during peak demands. The pipe line systems utilize similar techniques for the purposes of controlling valves to reroute or inhibit the flow of materials in the event of a failure of section in a pipe line network.

Data needs which are common to most Public Services entities are security system monitoring, location systems, and inventory access systems. As with many other entities, security systems are essential to help protect lives and property from destruction or tampering by individuals. Location systems provide a means to track crews and equipment for the purposes of effective response to disruption of service as well as train collision avoidance. When a catastrophic event does occur, the Public Service entities rely on access to data bases which contain information concerning the availability of repair and restoration materials and equipment.

4.5.5 Video Requirements. As an extension of the security system monitoring item above, video surveillance provides much more information in specific situations than typical alarms can provide. Video systems are very valuable tools when Public Service entities respond to catastrophic events such as train derailments, tornadoes, hurricanes, as well as earthquakes. In may cases, the video surveillance would be most effective if made available through a wireless means.

4.5.6 Special Agents. Another application for communications in Public Services are those communications which occur between railroad police, also known as Special Agents, and local, state, as well as federal agents. The Special Agents have arrest authority if a crime occurs on the railroad right of way. They are often the first responders when dealing with murder, rape, robbery, drug enforcement, and vandalism to name a few. During derailments, the Special agents work with a variety of Public Safety entities to coordinate activities with the railroads in an effort to contain the disaster as quickly as possible. Most of the communications are voice, however, there is a significant need for data communications for the purposes of having access to the same information which is shared between the Police, Fire, and Rescue entities.

~~4.5 PUBLIC SERVICE~~

~~4.5.1 Mission. The mission of the Public Service working group is to catalog operational requirements for public service entities at the federal, state and local levels.~~

~~4.5.2 Introduction. One classification of public safety wireless communication users are those entities that rely on wireless systems to prevent catastrophes that endanger life and property. Entities such as transportation companies and public utilities operate communications networks that interface with classically defined local, state and federal public safety entities on a daily basis. One primary purpose of these networks is to minimize risk to the public. These networks also aid other public safety providers in performing their missions when a catastrophe does occur. This section of the report identifies many of the current communications requirements of this class of wireless communication users.~~

~~4.5.3 Voice Requirements.~~

~~Dispatcher to Crews. This is a typical communications path between dispatchers and field personnel. The call types are typically business oriented with emphasis on operating the business in a safe and~~

~~efficient manner.~~

~~Crew to Crew. This function relates to the typical communications between field users. These communications are used for the coordination of daily activities to maximize the safety and efficiency of operations.~~

~~Emergency Call. This function is typically initiated from a field user to a dispatcher. As the name implies, the call type is that of an emergency where loss of life or property is imminent or has already taken place.~~

~~"Talk Around". In many operations between field users, routing a call through the network or a repeater is not feasible for reasons such as access delay or being out of range of the system. A talk around mode is necessary so that the field users can communicate with each other, within the range of their mobiles and portables, without the assistance of a network or repeater.~~

~~Interconnect. In nearly all field activities, users have a need to communicate with people by way of land line telephones. Telephone interconnect is a necessary option for many of the present day radio systems.~~

~~4.5.4 Data Requirements.~~

~~End of Train Control. This is a system which provides a data communications link between the end of the train and the train crew. With this link, the engineer of the train can determine if the end of the train is in motion, what the brake line pressure is and whether the end of train flashing marker is illuminated. The engineer can also apply the brakes from the end of the train by remotely releasing the brake pipe pressure. All functions associated with this device relate to safer handling of the train.~~

~~Positive Train Control. This is a data system which utilizes a computer on board the locomotive to minimize collisions between trains. The locomotive computer obtains movement authorities from a host computer and calculates when it needs to stop the train based on the speed and weight of the train. If the limits of authority are going to be violated, the computer will stop the train automatically.~~

~~Track Warrants. Track warrants are the movement authorities which are used by the train engineer. Track warrants are typically read to the engineer over the radio system by the dispatcher. There are plans in place to provide a data link between the dispatcher and the train engineer to reduce errors in copying the track warrant.~~

~~Crossing Safety. Crossing accidents are of great concern to the railroad industry. Systems are being investigated which will provide a notification to public safety vehicles and school busses that a train is approaching a specific crossing which may affect them. This will provide added warning of approaching trains.~~

~~In addition to the warning systems, data links are being investigated which will be used to report any malfunctions with the railroad crossing. Defects such as inoperative or broken crossing arms, vandalism, as well as power failures can be reported to maintenance personnel.~~

~~Cab Signals. Cab signals provide a visual warning to the train crew as to the status of the track immediately ahead of them. As an example, if the track is occupied, the signals to the train crew will show red. If the track is clear, the signals will show green. This form of alerting the crew is very helpful in train control and collision avoidance.~~

~~Train Line. The current form of braking for trains is through a pressurized brake line. If the air pressure is reduced, the brakes of the cars as well as the locomotives are applied. Often the air pressure does not respond as quickly or as fully as needed by the train engineer, creating a problem with train handling.~~

~~A train line is being developed which will provide a communications path thorough the train. One of the functions of the train line will be to provide electronic breaking information to each car, eliminating the need for the air line.~~

~~Consist Telemetry. An extension of the train line function listed above is a communications system which handles information for all items being transported. Typical information includes the condition of the cargo in terms of over temperature or rough riding which would be helpful when transporting hazardous materials. Other uses would be to provide additional alarming to the train crew for purposes of theft and vandalism control.~~

~~System Protection Telemetry. The power utilities rely on communication links to assist in monitoring and control of power distribution systems. Very large and fast acting circuit breakers obtain information about short circuits and disconnect the power source in order to minimize risk of life and damage to property. These communication links are also utilized in the substations which are used to reduce the voltage of the transmission systems for distribution to households.~~

~~Load Shed Telemetry. On a smaller scale from system protection as described above, load shed telemetry is used to control the amount of power used by consumers. A data communication system is used to remotely control air conditioners and electric water heaters in an attempt to minimize overloading of the transmission and distribution systems.~~

~~Defect Detector Communication Link. Defect detector communication is typically one way and is composed of a low power transmitter located at the detector sites. If a defect is detected, a synthesized voice radio transmission is sent. This will alert the crew of the train in the area of the detector before injury and/or damage occurs.~~

~~The following is a list of typical defect detectors:~~

~~1. Hot box/journal.~~

~~2. Dragging equipment.~~

~~3. High and wide equipment.~~

~~4. Rock slide/mud slide.~~

~~5. Flood.~~

~~Security System Monitoring. Property and equipment need to be monitored via security systems. Most of the applications require some form of wireless communications to establish the link.~~

~~Location Systems. For train control, location systems such as GPS are needed to obtain the location of the train in relation to limits of movement authority as well as other trains. Unfortunately, standard GPS does not have the required accuracy which can be accomplished by Differential Global Positioning Systems (DGPS). One of the requirements for the DGPS system is that the users must have a secondary data link which is independent of the satellite link.~~

~~Inventory Access. Both railroad and utility industries have situations where access to a store department record would facilitate derailment clean up or storm restoration respectively. To accomplish this, a data link between the field user and a host computer is necessary in order to determine and acquire needed materials.~~

~~4.5.5 Video Requirements.~~

~~Video Surveillance. As an extension of the security system monitoring item above, video surveillance provides much more information in specific situations than typical alarms can provide. In may cases, the video surveillance would be most effective if it was available through a wireless means.~~

4.6 HIGHWAY MAINTENANCE

4.6.1 Mission. The mission of the Highway Maintenance working group is to catalog operational requirements for highway maintenance at the state and local levels.

4.6.2 Introduction. Organizations at federal, state and local levels are charged with specific highway maintenance activities. Activities of these organizations include maintenance and construction of roads, highways, tunnels, bridges required to allow safe thoroughfare of the general public. Communications needs are based on official duties.

The Highway Maintenance mission is to serve the public by establishing a transportation system that emphasizes safety, environmental preservation, costeffectiveness and quality.

4.6.3 Voice Requirements

TwoWay Voice Communications. Dispatch requirements usually fall into the categories of maintenance or construction activities. Both require dispatch operation to control and manage activities. Wireless voice dispatch is critical to controlling costs and coordinating projects.

Voice communications are necessary from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted or hand held portable radios.

Telephone System Access. Interconnect capabilities are required for management level to interface with the public and provide semiprivate contact at a management level. Mobile mounted or hand held portable radios which have system access to the public switched telephone network would be necessary.

Interoperability. Mutual aid considerations are vital to highway operations. Highway maintenance crews are often the first to arrive on the scene of accidents and require a method of contacting appropriate emergency response entities. Incidents occurring on or adjacent to highway right of way also require response by highway maintenance units to provide primary traffic control, emergency repair, detours along with providing general assistance to other public safety responders. A primary consideration is weather associated operations such as snow removal which is very critical to other public safety entities being able to perform their function. The ability to interface with other aspects of public safety are essential.

Connections to remote traveler information systems such as localized broadcast transmitters providing the public with timely road condition information.

4.6.4 Data Requirements

TwoWay Mobile and Portable Data Terminals. Field computers capable of remotely accessing information systems and files. May be used for dispatch or field support to perform real time changes to system data. Equipment may be vehicle mounted or a hand held portable unit.

Mobile unit status and control provide essential cost and time saving abilities to day to day operations. Unit status as well as road condition status can be transmitted by data exchange increasing the timeliness and accuracy of information.

Administrative data transfer allows for overhead information exchange for a work force that is remote and mobile.

Telemetry Systems. Monitoring of infrastructure integrity such as water flow and height at bridges, mud flow areas, high wind areas provide instant information and warning freeing up personnel and equipment to perform their functions more efficiently.

Infrastructure inventory and control can be transmitted as data allowing better control of required maintenance of structures such as bridges and signs.

Remote Public Information Systems. Changeable signs and traveler information radio systems. Weather

and road condition data transfer from remote sites.

Vehicle and Device Location Tracking. Vehicle location information allows more efficient use of equipment utilization, equipment management inventory and location control. The amount and location of material such as sand and asphalt both in storage and application. Road maintenance management including bridge, buildings and signs. Road surface condition and repair needs inventory data acquisition. Road construction survey information requires differential Global Positioning System (DGPS) accuracy. Accuracy for all of these requirements depend on the availability of DGPS. DGPS is provided by many means including transmission over dedicated public safety frequencies.

4.6.5 Video Requirements

OneWay Video. Ability to view specific locations or interests through either snapshot, real time or close to real time accuracy to monitor traffic flow from remote sites.

4.6.6 ITS Intelligent Transportation Systems. Many of the ITS requirements fall to the highway programs. These range from public information dissemination to monitoring transport vehicles regarding weight/height/fuel permits.

Section 4.7 provides a detailed description of services that fall into this range of applications.

4.7 Intelligent Transportation Systems (ITS)

4.7.1 Purpose. Innovative applications planned within this services may be unfamiliar to many in the public safety community especially those designed to aid in emergency vehicle response. ITS represents a broad range of applications that, because of their ability to enhance performance of different public safety communities' transportation and operations, apply horizontally across many other public safety communities' requirements. As a result, ITS-related operational requirements appear in some of the other sections of this report. It should be noted that the operational requirements for ITS defined in this section of the report are derived from the ITS National Architecture and the user services on which the architecture is based.

Many of the applications will enhance the safety of the individual traveler, and will be available to both personally owned vehicles as well as vehicles owned and operated by traditional public safety agencies. This creates an environment where spectrum use may be shared between public safetyrelated, ~~and~~ public service and non-safety related functions.

4.7.2 Introduction. The Intermodal Surface Transportation Efficiency Act was passed by Congress and approved by the President in December 1991. It formally established the Intelligent Transportation Systems (ITS) program, which seeks to apply advanced communications and computer technologies to surface transportation systems in order to decrease traffic congestion, improve safety, reduce transportation related environmental impacts, and increase productivity. Public safety goals of the Intermodal Surface Transportation Efficiency Act (ISTEA) legislation being addressed by ITS are reducing the frequency of accidents, reducing the severity of accidents, reducing congestion due to incidents and enhancing traveler security.

In order to reduce the time and cost of implementing such a system, existing communications services will be used to the extent possible, provided they can meet ITS requirements. Some systems will require wireless data communications technologies such as dedicated short range communications (DSRC using roadside readers and vehicular mounted transponders) or may require the use of collision avoidance radar. There are likely to be ITSspecific systems or applications requiring new spectrum.

The relationship between ITS and public safety has several aspects including: the safety of the traveler and the safety of public safety personnel performing mission related functions.

4.7.3 Operational Needs. Public Safety features of the Intelligent Transportation Systems network:

.. Emergency vehicle location tracking

.. Emergency vehicle route guidance

.. Emergency vehicle signal priority

.. Driver and personal security

.. Automatic collision notification

.. Enroute driver information

.. Invehicle signing

.. Incident detection and management

.. Probe data for traffic control

.. Transit management

.. Priority treatment for transit

.. Public travel security

.. Automated roadside inspections

.. Weight in motion

.. Automated vehicle classification

.. International border crossings

.. Electronic clearance

.. Onboard safety monitoring

.. Hazardous materials incident response

.. Collision avoidance

.. Intersection collision avoidance

.. Safety readiness

.. Precrash restraint deployment

.. Automated highway system checkin

.. Highwayrail intersection safety

4.7.4 Descriptions of each Typical Operational Requirement

Emergency vehicle location tracking: Wireless data communications will be used to collect positionlocation information and data from emergency vehicles to improve the monitoring and display of emergency vehicle locations and help dispatchers efficiently task the units that can most quickly reach an incident site.

Emergency vehicle route guidance: Route guidance information is sent via wireless data communications to direct emergency vehicles equipped with guidance and navigation displays to an incident location. Directions are provided based on realtime information collected concerning traffic conditions and road closures in developing the best route.

Emergency vehicle signal priority: Signal priority uses wireless data communications to clear traffic signals in an emergency vehicle's route. In order to facilitate speedy movement for emergency vehicles, the vehicle can (with the help of an "onboard transceiver") alter the timing of traffic signals in the immediate vicinity (via the "fixed reader" mounted beside the traffic lights) to generate a "green wave" (a series of green signal lights in the desired direction of travel).

Driver and personal security: Wireless communications will be used for user initiated distress signals for incidents ranging from mechanical breakdowns to car jackings.

Automated collision notification: Sensor technology is used to identify when a vehicle has had a collision and information is automatically sent via wireless data communications regarding location, nature, and incident severity to emergency personnel.

Enroute driver information: Wireless data communications are used to provide driver advisories conveying information about traffic conditions, incidents, construction, and weather conditions to drivers of personal, commercial, emergency, and public transit vehicles. The information may be provided by state and local authorities, transit authorities, and emergency management centers.

Invehicle signing: Transmitters installed at critical points of a roadway are used to transmit data containing driver safety advisories and warnings on road hazards which could be displayed and/or enunciated to travelers in vehicles.

Incident detection and management: Sensor technology, digitized video and wireless data communications are used to help public officials quickly and accurately identify a variety of transportation system incidents, and to implement a response which minimizes the effects of these incidents on the movement of people and goods.

Probe data for traffic control: Continuous collection and transmission of vehicle counts, flow data, and travel times by wireless data communications incorporating positionlocation data provides information needed for traffic management, emergency fleet management and route guidance. This also provides state and local traffic management centers with realtime detection of obstructions due to traffic incidents and road hazards (this is a special case of the surveillance capability needed to effectively manage the transportation system).

Transit management: Wireless data communications are used to maintain position location information on transit vehicles and to transfer data between transit management centers and transit vehicles. Transit vehicles can be instructed to adjust their schedule or route to allow for incidents or bad road conditions. Within the transit vehicle, this information can also be utilized to provide automatic signage and annunciation of the next stop.

Priority treatment for transit: Identification of transit vehicles at access points of HOV lanes or at intersections can be used to provide priority treatment for these vehicles via appropriate adaptation of signal timing. This is accomplished by wireless data communications between the transit vehicle and the control signal or a transit vehicle and a traffic/transit management center that can exercise signal control.

Public Travel Security: Wireless video and data communications can be used for systems monitoring the environment in transit stations, parking lots, bus stops, and transit vehicles and generate alarms either automatically or manually as necessary. This improves security for both transit riders and operators.

Automated roadside inspections: Inspections are performed on commercial vehicles using wireless data communications allowing "realtime" access at the roadside to the safety performance records of carriers, vehicles, and drivers. This enables safety inspectors to access these records from the roadside.

WeightInMotion (WIM): Weight measuring equipment (fixed sensors embedded in the pavement or portable and temporarily deployable equipment) can ascertain the weight of a commercial vehicle at highway speeds to ensure the vehicle is operating within the rated safety limits. Wireless data communications systems are used to match the weight data obtained with the relevant credentials in the official database while the vehicle is in motion.

Automatic Vehicle Classification (AVC): Inpavement sensors, in conjunction with the roadside wireless data transceivers (and, perhaps, an inspection facility computer), are used to count the number of axles of a commercial vehicle for classification, and match the data with the vehicle.

International border crossing: Using automated vehicle identification (AVI), commercial vehicles are identified via wireless data transmission to a roadside reader and matched to its Precleared credentials, allowing the vehicle to proceed without stopping. This service enables the carriers to Preclear vehicles at international border crossings. Automating this process implies cooperation of registration, fuel tax, immigration, safety enforcement, and customs agencies, as well as the state transportation agencies.

Electronic clearance: A wireless data communications system would be used to identify a commercial vehicle and its electronic credentials would be verified automatically while the vehicle is traveling past the roadside reader at highway speeds. This would allow commercial vehicles to travel across state borders without being stopped for verification of paperwork and permits regarding fuel usage and tax, registration, safety clearance, etc. Combined with the networking infrastructure, which would connect roadside readers to central databases and administration centers, this service will facilitate state tax report preparation, auditing, and insurance requirements.

Onboard safety monitoring: Safety data is provided to enforcement personnel, carriers, transit authorities, and drivers to review the safety status of a commercial vehicle, its cargo, and its operator, over a wireless data communications link as the vehicle passes the roadside reader while traveling at highway speeds. Safety conditions of the vehicle and the driver including the condition of critical vehicle components such as brakes, tires, and lights, and sensing unsafe conditions such as shifts in cargo while the vehicle is in operation would be stored as data on the vehicle, and interrogated using wireless data communications from the roadside.

Hazardous materials incident response: The safety of shipments of hazardous materials is enhanced by providing enforcement and response teams information from the vehicle via wireless data communications on the nature and location of any incident, and the type of material involved in order to enable safe and efficient response.

Collision avoidance: Radar is used to provide crash warnings and some degree of vehicle control for lane changes, road departures, and potential or impending collisions. It will help reduce the number of longitudinal and lateral collisions involving two or more vehicles, and crashes involving a single vehicle leaving the roadway.

Intersection Collision Avoidance: Drivers are warned of imminent collisions when approaching or crossing an intersection that has traffic control (e.g., stop signs or traffic signals). This application uses wireless data communications at the various arms of an intersection to sense the speed and direction of passing vehicles, which in turn, is coordinated by a roadside processor (or master reader for that intersection). Appropriate messages are dynamically transmitted to vehicles warning them of a potential collision.

Safety readiness: Radar equipment onboard the vehicle will be used to detect unsafe road conditions, such as bridge icing and standing water on a roadway, and provide warnings to the driver.

Precrash restraint deployment: Radar identifies the velocity and direction of vehicles and objects involved in a potential crash. Responses include tightening lapshoulder belts, arming and deploying air bags at an optimal pressure, and deploying roll bars.

Automated highway system (AHS) checkin: Automated checkin using wireless data communications between the roadside and the vehicle at the entrance of (AHS) lanes will be used to examine laneworthiness of a vehicle by verifying qualifying credentials for the vehicle, driver and carrier on their safety ratings and status. This ensures that both the driver and vehicle have passed the necessary safety checks to travel on automated highways.

Highwayrail intersection safety: Vehicle Proximity Alerting Systems (VPAS) will use wireless communications to provide warning messages to vehicles concerning the approach of trains at highwayrail intersections.

4.8 FORESTRY

4.8.1 Mission. The mission of the Forestry working group is to catalog operational requirements for forestry operations at federal, state and local levels.

4.8.2. Introduction. Organizations at federal, state and local levels are charged with the specific oversight of our nation's environmental and agricultural resources. Activities of these organizations include management of forests, riparian environments, parks and various other environmental and agricultural resources for the common good of the general public.

The Forestry/Conservation mission is to serve the public through its activities directed to conserve, improve, and protect natural resources and environment. Communications needs are based on the performance of official duties.

Major activities in the management of the fragile and limited public resources associated with forest, wildlife, fish, recreation and other renewable resources include enforcement of environmental conservation laws; maintenance of air & water quality; hazardous, toxic, and solid waste management; mined land reclamation; wetland protection; environmental impact analysis; pesticide use regulation; fish & wildlife management; stream protection; park & primitive area management; and forestry.

The Forestry/Conservation mission emphasizes safety, environmental preservation, costeffectiveness and quality. A specific component of Forestry/Conservation activity includes public safety response in such areas as law enforcement, rural and rural/urban interface fire protection, first response medical assistance, search and rescue, and boating safety.

Varied and wide area response including air support require dynamic frequency assignments for all operational categories through well coordinated procedures. Forestry/Conservation Communications systems require areas of operation covering entire states or regions.

4.8.3 Voice Requirements

TwoWay Voice Dispatch. Dispatch requirements usually fall into the categories of maintenance and management activities. Both require dispatch operation to control and manage activities. Wireless voice dispatch is critical to controlling costs and coordinating projects including mutual aid interoperability with other Public Safety Service providers. Law enforcement actions in Forestry/Conservation usually take place in remote isolated areas dealing with groups or individuals who are often difficult to deal with emphasizing the importance of a robust communications infrastructure and mutual aid interoperability requirements.

Voice communications are required from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted or hand held portable radios. In addition, voice communications in harsh terrain may require the use of vehicular communications repeaters to retransmit signals.

Air to Ground. Air to ground communications are necessary when aircraft perform wildfire detection and suppression, conservation law enforcement investigations and patrol, inspections of reclamation projects and contamination sites, and while tracking wildlife and transporting personnel.

Fisheries Operations. Voice communications are necessary to support transportation of fish, fish tracking, habitat and species studies, fish catching for species development, and fish ladder construction and operation.

Conservation Law Enforcement. Conservation officers in most states are full-time peace officers. Voice communications are required to support conservation law enforcement operations, marine safety enforcement and patrol, hunter safety training, poaching investigations, citizen evacuations, traffic control, and search and rescue missions. Conservation officers also must have the ability to contact other law enforcement officers to request and provide mutual aid.

Wildlife Management: Voice communications are required by conservation officers and staff to support transportation of animals, along with tracking and general management of various species of wildlife.

Wildfire Detection and Suppression. Voice communications are required for mutual aid with other states agencies, foreign governments, federal agencies, and local municipal fire suppression agencies. Forestry or conservation agencies provide the first response in many states because of the heavy equipment resources of such agencies, the availability of a reliable state-wide radio communications system and the availability of caches of handheld communications devices for on-scene activities.

Park and Recreation Area Management. Voice communications are required to support operation of state parks and mooring facilities by forestry and conservation agencies. Activities involved in this requirement include construction of facilities, traffic control, facilities maintenance, fire suppression, boating safety, beach patrol and life guard services, basic first aid and emergency medical response. The essential nature of these services often is magnified by the geographically remote nature of park.

Environmental and Waste Management Operations. Voice communications are required to support contamination investigations and site management during cleanup and restoration.

Telephone Interconnect. Interconnect capabilities are required for management level to interface with the public and provide semiprivate contact at a management level. Telephone System Access would be accomplished through mobile mounted or hand held portable radios which have system access to the public switched telephone network.

Interoperability. Mutual aid considerations are vital to Forestry/Conservation operations. Forestry/Conservation crews are often the first to arrive on the scene of accidents in remote areas and require a method of contacting and coordinating with appropriate emergency response entities. The ability to interface with other aspects of public safety during ongoing natural disaster incidents are essential.

Wireless Public Announcement System. Public announcement broadcast information systems such as localized broadcast transmitters providing the public with timely area specific resource and safety information.

4.8.4 Data Requirements

Portable & Mobile Data Terminals. Mobile unit status and control provide essential cost and time saving abilities to day to day operations. Unit status as well as resource condition status can be transmitted by data exchange increasing the timeliness and accuracy of information. Routine administrative data transfer allows for overhead information exchange for a work force that is remote and mobile. Resource management and condition reporting are an essential component of large scale incidents such as wildland fires.

Data collection and monitoring of public environmental resources such as water flow and quality provide instant information and warning freeing up personnel and equipment to perform their functions more efficiently. Infrastructure inventory and control can be transmitted as data allowing better control of required maintenance of resource support facilities.

Public Information Systems. Remote public information systems such as changeable signs and public information radio systems. Weather and resource condition data transfer from remote sites linked to administrative sites.

One Way Data Transmission/Telemetry. Data monitoring of fish and wildlife to allow better resource management.

Vehicle, Device, and Wildlife Location Tracking. Location information allows more efficient use of equipment utilization, equipment management inventory and location control. The location and control of limited resources during routine and extended emergency incidents is crucial to safe and quick mitigation of such incidents.

Facilities management. ~~includes bridge, buildings and signs. Routine infrastructure maintenance and repair requires inventory data acquisition.~~ Facilities management includes oversight of bridges, buildings and signs. Data transmission support assists infrastructure and repair through maintenance of inventory and status information. Also, r~~R~~esource identification requires survey information utilizing differential Global Positioning System (DGPS) accuracy. Accuracy for all of these requirements depend on the availability of DGPS. DGPS is provided by many means including transmission over dedicated public safety frequencies.

Wildfire Detection and Suppression. Data transport is required to support transmission of weather-related data and area vegetation and combustible materials inventory data.

Environmental and Waste Management Operations. Data transport is required to support transmission of data regarding water quality, well contamination and other data from remote monitoring or control systems.

4.8.5 Video Requirements. Real time and close to real time incident monitoring from remote sites (including airborne) provide up to date information on such incidents as wildland fires as well as crowd control in routine parks environments. Infrared real time mapping of fire via airborne resources.

4.9 GENERAL GOVERNMENT

4.9.1. Mission. The mission of the General Government working group is to catalog operational requirements for general government operations at federal, state and local levels.

4.9.2. Introduction. The general governmental group's needs are diverse in nature since they perform a myriad of tasks to carry out their respective mission. This group includes any United States territory, possession, state, county, city, town, village or similar governmental entity, including a district and an authority. The need is for essential communications necessary to fulfill official governmental ~~activities~~ responsibilities.

A major portion of this section is based on the needs of large urban regions since there are a broad range of uses in densely populated areas. In addition, the needs of surrounding suburban and rural areas were also taken into account for these regions. General Governmental services focus on legislative, community and general matters all of which are a function of government. ~~the New York City Government. The City of New York is managed through the Office of the Mayor. The Mayor has deputy mayors responsible for specific governmental duties and oversight. There are many other mayoral offices and departments that focus on legislative, community, and general matters all of which are a function of government.~~

~~The City of New York has many individual departments that currently fall within the scope of the General Government Communications Service ranging from the Department of Aging, through the alphabet, to the Department of Youth Services. Also under the New York City Department of Information Technology and Telecommunications' (NYCDoITT) technology jurisdiction fall some emergency responder agencies that are not included within this work group report since their needs are~~

~~presented through other sections. The information represented here satisfies the needs of the City of New York as a governmental entity.~~

4.9.3 Voice Requirements. Voice communications is the most widely used method of communications for the general governmental agency. Dispatch requirements are necessary for day to day operations to accomplish specific agency missions in a timely and cost effective manner.

Communications are directed towards management of field personnel, control of workload distribution, and coordination of services affecting public safety. Agencies in the general governmental category are most likely the "public safety support" service providers who provide the tools necessary for emergency responders to fulfill their tasks.

Another aspect of the general governmental service is direct public safety. Many times a general government service is called upon to act on a routine matter of public interest such as a housing, heating, or community assistance matter only to be faced with a potentially volatile situation requiring immediate attention from specific governmental groups. Immediate action on these matters from the general government groups calms the tension of the public and involved parties reducing the risk of major public safety incidents such as riots.

Typical voice communications would be from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted or hand held portable radios.

Telephone System Access: Interconnect capabilities are required for certain management levels to interface with the public and provide semiprivate contacts at with other public services. Telephone System Access would be accomplished through mobile mounted or hand held portable radios which have system access to the public switched telephone network through dedicated links or through commercially available services. A necessary consideration is that the device utilized for voice communications be a singular piece of equipment capable of all voice features. Mobile mounted or hand held portable radios would be necessary in order to facilitate the field office workers' needs.

Interoperability. Mutual aid considerations are vital to General Government. Governmental services require interaction among other regional public safety services and public service entities for both routine and emergency situations.

4.9.4 Data Requirements

TwoWay Mobile and Portable Data Terminals. General Government uses f~~F~~ield computers capable of remotely accessing information systems and files. Field Computers m~~M~~ay be used for dispatch or field support to perform real time changes to system data. Equipment may be vehicle mounted or a hand held portable unit.

Mobile unit status and control provide essential cost and time saving abilities to day to day operations. Administrative data transfer allows for information exchange for a work force that is remote and mobile.

Oneway Data Transmission & Telemetry Systems. General Government requires r~~R~~eal time information transfer from field locations (fixed, mobile, or portable) to fixed control points. Transmission is used to monitor the functions of a system, site, or device. This may also incorporate a type of personal paging device used to alert personnel with limited alphanumeric messages.

Remote Public Information Systems. Changeable signs and public information systems with the ability of the authorized entity are used to dynamically change visible street signs/bulletin boards and ~~etc., to~~ alert the public to ~~of~~ potential hazards or delays.

Vehicle, Personal, and Device Location Tracking. Location information allows more efficient use of equipment and personnel utilization, equipment management inventory and location control. The ability of dispatch control point or other vehicles to monitor apparatus locations within the geographical service

area would improve efficiency of services provided by the governmental agency.

Since many general governmental field personnel are not assigned to a vehicular mandated task, there is a need for a personal location device to track the location of an assigned individual in the event of an emergency. This tracking device may be incorporated within the voice communications equipment or be a separate personal device.

As stated within previous sections, the accuracy for all of these requirements depend on the availability of DGPS. DGPS is provided by many means including transmission over dedicated public safety frequencies.

4.9.5 Video Requirements

TwoWay Portable Video. Twoway portable video capabilities enhances the voice communications need for general government since field units and dispatch control points would be able to communicate using real time video with voice from mobile or hand held portable radios.

OneWay Video. One way video gives the ability to remotely view specific locations or interests through either snapshot or real time video as necessary throughout the jurisdiction.

4.10 PUBLIC MASS TRANSIT

4.10.1. Mission. The mission of the Public Mass Transit working group is to ~~it so~~ catalog operational requirements for public mass transit operations at regional, state and local levels.

4.10.2. Introduction. Governmental Public Mass Transit organizations operate transportation systems (i.e. trains and buses) which on a regular basis transport passengers. These organizations have the responsibility for the safety and general welfare of the passengers during transportation.

Emergency railroad mass transportation incidents, for example, occur primarily as a result of vandalism to tracks and equipment or weather conditions. Operational needs to address these issues are incorporated within this report and represent not only operations, but also system safety, property protection, and maintenance responsibilities. The need for communications is based on safety and operations of the system.

The majority of the operational requirements are based on the needs of major metropolitan areas where government is charged with providing these services, where massive amounts of people are transported daily, and services are essential to the general public. ~~the Metropolitan Transportation Authority s New York City Transit Authority (MTA-NYCT).~~

~~In 1968, the New York State Legislature created the Metropolitan Transportation Authority (MTA) to oversee transportation in twelve (12) counties of the New York City metropolitan area. The Metropolitan Transportation Authority is a New York State entity that is the coordinating body of the public transit agencies listed below:~~

~~New York City Transit Authority~~

~~Metro-North Commuter Railroad~~

~~Long Island Railroad~~

~~Triborough Bridge and Tunnel Authority~~

~~Metropolitan Suburban Bus Authority~~

~~MTA Card Company~~

~~The MTA family of agencies provide subway, bus, and commuter rail service to millions of residents, commuters and visitors in addition to operating seven bridges and two tunnels. Without them New York City could not be the center of finance, commerce, culture, and entertainment that it is today.~~

~~The New York City Transit Authority (MTA-NYCT) operates every day, 24 hours a day and provides essential public transportation service to the five boroughs of New York City. MTA-NYCT has the largest rapid transit system and the largest bus transit system in the nation. On an average weekday, the subway serves 3.6 million passengers and buses serve 1.5 million passengers. Ridership (1.1 billion rides per year) ranks MTA-NYCT as sixth in the world, but the number of actual subway cars ranks the MTA-NYCT as the largest fleet in the world. MTA-NYCT's work force consists of approximately 44,000 employees who support the New York City public transportation system.~~

~~MTA-NYCT's governmental efforts are focused on the more than 5 million people who travel with them every weekday by subway trains and buses. Its passengers are entitled to safe, orderly, crime free, comfortable and efficient transportation. In order to ensure these, MTA-NYCT hopes to incorporate new technologies -- in communications and operations -- to meet our passengers needs. New technologies for train control, other operational improvements and signal communications, as well as the need for effective, prompt and reliable voice communications, all require that future spectrum availability can be assured.~~

~~MTA-NYCT continues to orient and revise its services to meet passenger needs and to provide a safe public transportation system. The MTA-NYCT is a governmental entity providing public mass transportation services and submits its Operational Requirements under the category of Public Mass Transportation.~~

4.10.3 Voice Requirements

Two-Way Voice Communications. Dispatch requirements are in the categories of operations, system safety, property protection, and maintenance activities. All require dispatch operation to control and manage activities. Immediate access to a dedicated wireless voice dispatch system is critical to safety and coordination of operations.

Incidents occurring on or adjacent to roadways or train track right of ways require actions by public mass transportation providers. Public transportation personnel are often the first to report, respond, and arrive to emergencies occurring within their systems. Field transportation crews work to rectify the underlying problem, in addition to directing and assisting passengers.

If, f~~F~~or example, a train ~~when a rush hour subway train in New York City~~ is stranded in an underground river tunnel without power due to a mechanical failure, its ~~approximately 1100~~ passengers are subjected to extreme conditions. ~~The c~~Climate control systems and main lighting in this disabled train may not be operating properly. ~~Increasing the potential for problems, o~~Other trains may be within the same tunnel behind the incapacitated train, forcibly trapped by the first. The cramped passengers of both trains become increasingly apprehensive of the situation and eagerly look forward to a rapid response from crews. The condition, which may only require the presence of ~~a railroad car mechanic or electrical maintainer~~ maintenance personnel, may grow to a multiple casualty incident due to passengers exposure to extreme conditions of temperature and confinement. Immediate communications to appropriate emergency response maintenance personnel is imperative to avoiding a major public safety incident with potentially disastrous results.

Voice communications are necessary from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted or hand held portable radios. The area of operation for Public Mass Transportation Providers communications may be in harsh locations such as below ground or waterway tunnels in addition to outdoor areas ranging from dense urban areas through mountainous rural areas.

Telephone System Access. Interconnect capabilities are required for limited management levels to interface with the public and provide semi-private contact at a management level. Telephone system

access would be accomplished through mobile mounted or hand held portable radios which have system access to the public switched telephone network through dedicated links or through commercially available services.

A necessary consideration is that the device utilized for voice communications be a singular piece of equipment capable of all voice features. Mobile mounted or hand held portable radios would be necessary in order to facilitate the transportation personnel s needs.

Interoperability. Mutual aid considerations are essential to public transportation operations. Public Transportation agencies require a method of contacting and being contacted by emergency response entities.

Public mass transportation is a dynamic tool for the emergency management services. Buses and rail cars are routinely used to transport police, fire, and other personnel, including military personnel, to the scenes of incidents. In addition, public transportation entities in large urban areas are used to evacuate large number of people when necessary.

Wireless Public Address/Announcements. The ability of dispatchers or controllers to issue announcements to passengers on board buses or trains and those in the vicinity of stations regarding service serves a multiple of public safety roles.

~~An example of the public safety role of this ability occurred in the New York City Bus system where a mentally disabled student wandered away from her school bus and boarded a New York City bus in Staten Island. In a city of nearly 8 million residents this is hardly an event that makes the morning headlines. To the student, her parents, and teachers, however, locating her promptly was undoubtedly of critical importance. The student was reunited with her family because of a systemwide public address announcement in all buses. The announcement alerted the transit workers and the riding public of the description and urgency of finding this child.~~

Passenger Emergency Notification. A voice communications system primarily utilized to alert train crews of an emergency situation involving passenger safety such as medical emergencies or criminal activity is the passenger s only way of reaching out for assistance. This system would not only notify the on-board crew but also be capable of accessing a distress channel linked to public safety answering points.

4.10.4 Data Requirements. The data requirements of the Public Mass Transit entity can also be classified as working to improve operations, system safety, and maintenance functions.

Two-Way Mobile and Portable Data Terminals. ~~Use of f~~Field computers capable of remotely accessing information systems and files are ~~is becoming~~ increasingly used ~~implemented~~ in all transportation methods. Data systems may be used for dispatch or field support to perform real time changes to system data. Equipment may be vehicle mounted or be in the form of a rugged hand held portable unit.

One-Way Data Transmission. Telemetry or real time information transfer from field locations (fixed, mobile, or portable) to fixed control points is key in maintaining the integrity of equipment, track, and safety features. Transmission is used to monitor the functions of a system, site, or device can alert transportation vehicles, maintenance, and emergency workers to potential hazards. One way signaling devices can be used to alert these vehicles or persons and transmit limited alphanumeric messages.

Train Signal Data. A combination of on-board train data with information provided through an Intelligent Transportation System (ITS) suited to railroad operations is paramount in the avoidance of train collisions and improvement of system safety.

Variable Information Distribution. The ability of an authorized entity to dynamically change signs/bulletin boards etc.. to alert the public of potential hazards or delays on-board transportation vehicles and at stations is ~~a necessity of~~ necessary for the transportation provider. This improves efficiencies and gives up to date information to the public on any conditions affecting transportation.

A number of Intelligent Transportation System (ITS) features listed in the ITS portion of the report are also suited for the Public Mass Transportation provider. They are noted ~~listed~~ below:

~~Emergency vehicle location tracking: Wireless data communications will be used to collect position-location information and data from transit vehicles to improve the monitoring and display of emergency alarm activation to guide emergency responders to quickly reach an accident site.~~

Vehicle route guidance~~: Route guidance information is sent via wireless data communications to direct public transportation vehicles equipped with guidance and navigation displays. Directions are provided based on real-time information collected concerning traffic conditions and road closures in developing the best route.~~

Driver and personal security~~: Wireless communications will be used for user initiated distress signals for incidents ranging from mechanical breakdowns to car jackings.~~

Automated collision notification~~: Sensor technology is used to identify when a vehicle has had a collision and information is automatically sent via wireless data communications regarding location, nature, and incident severity to emergency personnel.~~

Enroute driver information~~: Wireless data communications are used to provide driver advisories conveying information about traffic conditions, incidents, construction, and weather conditions to drivers of personal, commercial, emergency, and public transit vehicles. The information may be provided by state and local authorities, transit authorities, and emergency management centers.~~

In-vehicle signing~~: Transmitters installed at critical points of a roadway are used to transmit data containing driver safety advisories and warnings on road hazards which could be displayed and/or enunciated to in vehicles.~~

~~Incident detection and management: Sensor technology, digitized video and wireless data communications are used to help public officials quickly and accurately identify a variety of transportation system incidents, and to implement a response which minimizes the effects of these incidents on the movement of people and goods.~~

~~Probe data for traffic control: Continuous collection and transmission of vehicle counts, flow data, and travel times by wireless data communications incorporating position-location data provides information needed for traffic management, emergency fleet management and route guidance. This also provides state and local traffic management centers with real-time detection of obstructions due to traffic incidents and road hazards (this is a special case of the surveillance capability needed to effectively manage the transportation system).~~

Transit management~~: Wireless data communications are used to maintain position location information on transit vehicles and to transfer data between transit management centers and transit vehicles. Transit vehicles can be instructed to adjust their schedule or route to allow for incidents or bad road conditions. Within the transit vehicle, this information can also be utilized to provide automatic signage and annunciation of the next stop.~~

Priority treatment for transit~~: Identification of transit vehicles at access points of HOV lanes or at intersections can be used to provide priority treatment for these vehicles via appropriate adaptation of signal timing. This is accomplished by wireless data communications between the transit vehicle and the control signal or a transit vehicle and a traffic/transit management center that can exercise signal control.~~

Public Travel Security~~: Wireless video and data communications can be used for systems monitoring the environment in transit stations, parking lots, bus stops, and transit vehicles and generate alarms either automatically or manually as necessary. This improves security for both transit riders and operators.~~

~~Electronic clearance: A wireless data communications system would be used to identify a passenger~~

~~public transportation vehicle while the vehicle is traveling past the roadside reader at any speed to give necessary clearance.~~

~~On-board safety monitoring: Safety data is provided to enforcement personnel, carriers, transit authorities, and drivers to review the safety status of a commercial vehicle, its cargo, and its operator, over a wireless data communications link as the vehicle passes the roadside reader while traveling at highway speeds. Safety conditions of the vehicle and the driver including the condition of critical vehicle components such as brakes, tires, and lights, and sensing unsafe conditions such as shifts in cargo while the vehicle is in operation would be stored as data on the vehicle, and interrogated using wireless data communications from the roadside.~~

Hazardous materials incident response~~: The safety of shipments of hazardous materials is enhanced by providing enforcement and response teams information from the vehicle via wireless data communications on the nature and location of any incident, and the type of material involved in order to enable safe and efficient response. This is important within the rail transportation sector since many public transit entities in suburban and urban areas share common tracks due to the lack of available real estate or governmental funding to construct dedicated passenger tracks.~~

Collision avoidance~~: Radar is used to provide crash warnings and some degree of vehicle control for lane/track changes, road departures, and potential or impending collisions.~~

~~Intersection Collision Avoidance: Drivers are warned of imminent collisions when approaching or crossing an intersection that has traffic control (e.g., stop signs or traffic signals). This application uses wireless data communications at the various arms of an intersection to sense the speed and direction of passing vehicles, which in turn is coordinated by a roadside processor (or master reader for that intersection). Appropriate messages are dynamically transmitted to vehicles warning them of a potential collision.~~

Safety readiness~~: Radar and data signaling equipment onboard the vehicle or train will be used to detect unsafe road or track conditions, such as bridge icing, standing water on a roadway, or track defects and provide warnings.~~

Pre-crash safety system deployment~~: Identification of vehicles and objects involved in a potential crash and evasive actions necessary prevent damage of property and loss of life.~~

Automated highway system (AHS) check-in~~: Automated check-in using wireless data communications between the roadside and the vehicle at the entrance of (AHS) lanes will be used to examine lane-worthiness of a vehicle by verifying qualifying credentials for the vehicle, driver and carrier on their safety ratings and status. This ensures that both the driver and vehicle have passed the necessary safety checks to travel on automated highways.~~

Highway-rail intersection safety~~: Vehicle Proximity Alerting Systems (VPAS) will use wireless communications to provide warning messages to vehicles concerning the approach of trains at highway-rail intersections.~~

4.10.5 Video Requirements. Video requirements are classified <u>regarding</u> ~~towards the~~ local operations, system safety and property protection aspects of transit.

One-Way Video gives the ability to remotely view specific locations or interests through either snapshot or real time video as necessary. For example, this feature allows railroad crews to monitor safety within train cars in response to incidents or activation of passenger emergency alarms plus view upcoming stations and track for safety risks.

Two-Way Portable Video would be necessary on a limited basis when system or passenger safety is necessary when responding to a remote station. Field units and dispatch control points could communicate using real time video with voice from mobile radios, hand held portables, or fixed sites.

4.11 CORRECTIONS

4.11.1 Mission. The mission of the Corrections

working group is to catalog operational requirements for correctional organizations at the federal, state, and local levels.

4.11.2 Introduction. Wireless communications

support is crucial to assure quality correctional services and create the safest possible working environment for correctional personnel. The following presentation is the product of discussion and correspondence with correctional officials from various locations in the United States. The emphasis of the working group has been on identification of present and future operational needs, dependent on wireless communication, without regard to cost or the current availability of technology. Needs are categorized into the three basic categories of voice, data and video. These needs are then organized into two sub-categories of correctional services: 1.) Prisons and Jails for facilities based operations; and 2.) Paroles and Probation for community based operations.

Correctional organizations across the country are a mix of both sworn and nonsworn personnel and have a unique and varied public safety mission. The operational public safety radio communications needs of correctional organizations will mirror one or more of those of all of the other commonly recognized public safety and public service organizations. Correctional organizations provide public safety in the forms of law enforcement, fire services, emergency medical services, emergency management and disaster services. They also provide public service in the forms of highway maintenance, fire prevention, conservation, the reintegration of offenders back into society and community public works.

Prisons and jails can be viewed as small but complete fully autonomous communities. In addition to the custody staff, a variety of support staff are needed. Cooks, laundry workers, firefighters, doctors, dentists, educators and maintenance people are needed to ensure inmates are housed, clothed, and fed accordingly. Activities, tasks and communications that may appear mundane, routine or administrative in normal circumstances take on significant public safety and security implications in the correctional environment.

4.11.3.1 Voice Requirements Prisons and Jails. In general, voice communications for correctional personnel must include coverage from portable to portable unit, through a system, radio to radio, or some other technology. Prisons and jails pose formidable challenges to intra and interbuilding communications due to their labyrinth design and heavy use of concrete, steel and rebar. Voice coverage from portable radios must include the ability to communicate from within these secure structures with a high degree of reliability. Correctional personnel must be able to speak with each other via the portable radio when they cannot see each other, whether between adjacent housing units or floors, or from one end of a secure campus style multiunit facility to the other.

The majority of prison and jail operations result in a high concentration of users in a relatively small, confined geographic setting. When traveling away from correctional facilities, voice communications requirements for correctional personnel mirror that of other law enforcement wide area coverage needs.

The prison and jail voice communications system must be expandable to support a relatively unlimited number of users quickly, i.e., 35 hours. Normal daytoday correctional operations may not require large volume radio capacity. However, when an inmate disturbance or some form of manmade or natural disaster impacts facility safety and security, the system must have the ability to expand to meet demand. The correctional environment requires the ability to remotely, across the air, selectively inhibit lost or stolen radios. A functional radio in the hands of an inmate significantly compromise the safety and security of an institution and the staff and inmates assigned therein. The ability to remotely "hotkey" a radio microphone aids in equipment recovery and/or intelligence gathering if equipped staff are taken hostage.

Voice communications for most routine prison and jail operations do not require encryption. However,

other operations such as disturbance control, staff investigations, and prison gang task force often will warrant a higher level of transmission security. Devices must be able to monitor both encrypted and nonencrypted messages simultaneously.

Staff to Staff Voice Communications. Voice communications routinely occur in an "advise and assist" format one a onetoone, or onetomany basis between correctional staff in a facility. Information conveyed commonly includes general coordination, operational instructions, administrative information, as well as tactical and emergency communications. The correctional voice communications system must provide support for routine voice communications between staff working throughout a facility.

Voice Dispatch. The need for voice dispatch in a "command and control" format varies depending on facility size and design. In some facilities, voice communications may routinely occur between correctional staff dispersed throughout a facility and central dispatch points. In others it only occurs during the response to an incident. Information conveyed commonly includes both operational instructions and information. The correctional voice communications system must support routine dispatch communications.

Special Operations Communications. Disturbance control response team operations and special investigations are a commonplace aspect of today's larger correctional facilities. A voice communications capability that is separate from normal operations voice traffic is required to support each special operation. These paths must have an extremely high security level of encryption capability available.

Statewide and Nationwide Travel Channels. A need exists for statewide and nationwide travel channels for use for prisoner transportation. The channels must be monitored nationwide and in mobile and portable units nationwide. Hundreds of thousands of convicted, often dangerous felons are transported within and between federal, state and local jurisdictions. Often times as these ground transports move through our communities they are without any form of routine or emergency communications. Direct access to the nearest public safety agency with the ability to provide emergency response is crucial as these ground transports are often hundreds of miles removed from their home jurisdiction.

Interoperability. Mutual aid considerations are essential to correctional organizations. Large scale inmate disturbances or the pursuit of escapees requires multiagency coordination. Correctional organizations often provide and supervise large inmate labor forces to assist in multiagency recovery efforts in response to manmade and/or natural disasters.

Voice Messaging Alarms. Operating safe and secure prisons and jails is very staff intensive and personnel costs are the lions share of operating budgets. To reduce the ongoing operational costs of incarceration, correctional organizations are searching for improved strategies. The incorporation of various electronic deterrence and detection systems have proliferated to reduce the need for staff resources. Many of these systems incorporate roving alarm notification systems to provide rapid voice based alarm information to responding correctional personnel, thus allowing less staff to patrol a larger area.

4.11.3.2 Voice Requirements Probation and Paroles. In general, voice communications for probation and parole personnel mirrors that of law enforcement. Probation and parole officers must be able to speak with each other or with other law enforcement officers. Probation and parole personnel often cover more than one law enforcement jurisdiction. Voice coverage from portable radios must include the ability to communicate from within buildings with a high degree of reliability.

Voice communications for most routine probation and parole operations does not require encryption. However, joint operations such as paroleeatlarge sweeps; narcotic eradication sweeps, etc. will often warrant a higher level of transmission security. Devices must be able to monitor both encrypted and nonencrypted messages simultaneously.

Voice Dispatch. Voice communications routinely occur between probation and parole personnel the field and central dispatch points. Information conveyed commonly includes both operational instructions and

information. The probation and parole voice communications system must support routine dispatch communications.

Officer to Officer Voice Communications. Voice communications routinely occur between one probation or parole officer in the field and one or more other officers in the field. Information conveyed commonly includes both operational instructions, administrative information, and general coordination. The probation and parole voice communications system must provide support for routine voice communications between probation and parole officers working throughout a particular jurisdiction.

Special Operations Communications. Probation and parole officers routinely participate in special investigations, task forces and other discrete activities that are a commonplace aspect of today's law enforcement community. A voice communications capability that is separate from normal operations voice traffic is required to support each special operation. These paths must have an extremely high security level of encryption capability available.

4.11.4.1 Data Requirements Prisons and Jails. The basic prison and jail requirement for data is immediate, clear transfer and display of text and graphical information for all correctional personnel, in support of both routine and emergency operations.

Mobile Data Computer/Terminal Applications. A need exists for realtime communications support of wireless mobile and portable computer systems capable of transmitting and receiving routine data queries and responses, electronic mail, location data and other graphics including fingerprints and mug shots, along with incidentspecific data and intelligence. Within a facility this may take the form of secure wireless LAN connectivity, or short hop microwave connections. Portable, wireless access to facility floor plan layouts for fire suppression or the development of tactical assault plan for special teams is essential to save lives. When traveling away from correctional facilities, wide area mobile data applications are required to manage transportation routing and scheduling.

Geographic Position and Automatic Location Data.

Correctional organizations require the ability to transmit location data, determined by geographic position technology or other means, automatically or on demand to other locations. As correctional organizations must monitor larger and larger inmate populations with less and less staff, prisons and jails have identified a need to monitor individual inmate movement and location within large facilities. Such systems may also provide for early detection of escapes between physical counts. Outside of facilities, there is the need for constant updating of vehicle positions for transportation dispatch and transportation officer safety purposes.

Emergency Signals. Correctional personnel in prisons and jails who need emergency assistance must be able to activate an alarm that sends an automatic distress notice to a central monitoring point and other staff in the facility. The sophistication of such systems varies from simple "panic buttons" that will activate a general alarm, to more complex systems that incorporate multiple features such as unique unit identification, automatic unit registration, mercury activated persondown switches and automatic unit location. Often times these systems are standalone from other communications systems such as voice radio in order to provide staff security to those who would otherwise not require a portable communication device.

Remote Device Monitoring. Prisons and jails require the ability to monitor remote device indicators via data transmission in order to maintain safe facility operations and secure perimeters. For example, the ability to monitor plant operations systems such as electrical power generation, water or sewer processing, and perimeter detection systems for any sign of failure. While loss of such services in the community for short periods can be inconvenient, in the correctional environment they can produce disastrous consequences. Additionally, the ability to remotely control or disable various plant or security operations is essential to isolating and containing an inmate disturbance from spreading to adjacent facilities.

4.11.4.2 Data Requirements Probation and Parole. The basic probation and parole requirement for data is

immediate, clear transfer and display of text and graphical information for all probation and parole personnel, in support of both routine and emergency operations.

Mobile Data Computer/Terminal Applications. A need exists for realtime communications support of wireless mobile and portable computer systems capable of transmitting and receiving routine data queries and responses, electronic mail, location data and other graphics including fingerprints and mug shots, along with incidentspecific data and intelligence.

Geographic Position, Automatic Location Data, Remote Device Monitoring. Probation and parole organizations require the ability to transmit location data, determined by geographic position technology or other means, automatically or on demand to other locations. A major role in incarceration is now being played out in the community by probation and parole organizations, where their charges are sequestered in their homes by remote electronic monitoring. The use house arrest has risen tremendously. Additionally, there is a mounting movement to develop systems and process to continually monitor and know the whereabouts of probationers, parolees and early release inmates on a 24 hour a day, 7 day a week basis. Proposed requirements have included a location accuracy of a few meters and a minimum five minute interval report time.

Emergency Signals. Probation and parole personnel who need emergency assistance must be able to activate an alarm that sends an automatic distress notice to a central monitoring point and other staff in the field.

Transmission of Reports. This system should accommodate transmission of forms and reports to central sites from mobile and remote locations. This capability will be used by probation and parole personnel to transmit arrest reports, report violations, request warrants and update case records files to central locations in long data streams of up to several seconds. This capability will reduce paper transactions, increase probation and parole officer field time, and speed transmission of vital information to command and administrative staff as well as other law enforcement agencies.

Electronic Messaging. Probation and parole officers require the ability to input messages into a data transmission device for transmission to single or multiple agencies, including other officers and other public safety providers. Due to their constant contact with the offender population, these staff often can provide substantive information to other law enforcement agencies.

4.11.5.1 Video Requirements Prisons and Jails. The basic prison and jail requirement video is immediate, clear wireless transfer of video for routine and emergency operations.

Incident Video. Some incidents like major inmate disturbances or hostage situations require realtime video. The capability must exist for both pointtopoint and broadcast use of the video. For example, full motion video must be transportable from the incident scene to an incident command post, and also to a remotely located emergency operations center.

Surveillance and Monitoring. As correctional organizations must monitor larger and larger inmate populations with less and less staff, prisons and jails have identified the need to use realtime video to monitor multiple secure areas from remote locations. Additionally, remotely operated video cameras are a great assets in reducing the introduction of contraband into facilities via visiting room settings.

4.11.5.1 Video Requirements Probation and Parole. The basic probation and parole requirement video is immediate, clear wireless transfer of video for routine and emergency operations.

Surveillance and Monitoring. Probation and parole requires the ability to transmit video snapshots at the rate of one frame each five seconds, for surveillance and monitoring purposes. For example individual, gang, building and low risk drug transaction surveillance would be adequately served by this quality of video transmission.

StillPhotographs. Probation and parole operations require the ability to transmit still photographs on demand to other locations. For example, a probation or parole officer in the field should be able to

transmit and/or receive a digital image of probationers or parolees to and/or from other officers and central dispatch points.

5.0 FEDERAL GOVERNMENT OPERATIONAL REQUIREMENTS

This section identifies operational requirements unique to federal government public safety/public services agencies. The diversity and complexity of federal agency missions compel the use of a wide variety of telecommunications capabilities.

Effective and reliable radio communications are required for federal agencies to perform Congressionally mandated functions dealing with safety-of-life, security and protection of federal property and military bases, protection of the President and other government dignitaries, enforcement of federal laws, protection of Native Americans, provide for immigration and border patrol, to operate federal prisons, protection of natural resources, security of our coasts and harbors, protection of natural resources, maintain and protect streams and inland waterways, distribution of water and natural resources, and many other essential missions.

To support these missions and responsibilities, federal agencies frequently use wireless platforms, such as, land mobile radio (LMR), HF, satellite, paging, cellular communications for clear and encrypted voice communications, audio and video monitoring, alarm systems, electronic tags and tracers, and limited data collection and transfer. These platforms are used both nationally and internationally, over diverse geographic conditions, often requiring subscriber unit interoperability and the ability to communicate on a priority basis 24 hours per day, 7 days per week.

From a LMR perspective, there are many similarities between federal uses of LMR systems and that of our state and local counterparts. However, national security implications, extensive geographical communications coverage requirements, privacy and security concerns are significant differences that require comment.

The Federal Government uses land mobile radio systems in support of the following: Law Enforcement, Transportation, Natural Resources, Emergency and Disaster Services, Utilities, Medical, and Administration functions.

5.1 Transport Mechanisms

Federal Land Mobile Radio systems planning and operations must include implementing features that ensure services continue to be available even in the most adverse conditions. Dependency on Land Mobile Radio systems requires those capabilities be available in times of emergencies when some key element of the transport mechanism (infrastructure) may be damaged or destroyed. Land-line based systems may not be available following earthquakes. Hurricane or other windstorms almost always damage wireless systems by bringing down towers and antennas. Some portions of the transport mechanism (infrastructure) are more likely to survive disaster than others.

Federal agencies rely on a mix of federally developed or owned linking mediums and commercial wireline and fiber networks to connect systems throughout the nation. When commercial services are used, federal agencies often configure the system for diverse circuit routing or apply National Security and Emergency Preparedness (NSEP) circuit restoration priorities.

In those areas where commercial service are not available, federal agencies use traditional point-to point and point-to-multi-point RF systems as outlined in section 4.1.

The experience of the federal, state and local community has shown that during times of natural disasters, especially earthquakes, the agency owned point to point radio systems are better able to withstand damage than commercial leased lines. It is also the experience of this community that during situations similar to the Oklahoma City bombing, the commercial systems quickly become overloaded preventing access and use by the law enforcement and public safety community causing further reliance on agency owned systems.

5.2 Law Enforcement

The patrolman on the city beat has a very different view of public safety from the Federal agent working an international terrorism conspiracy. Drug smuggling from outside the country is connected to drug violence in low-income city housing projects, but the people who combat drug smuggling work for different levels of government, have varying duties, and use different tools and techniques.

Effective and reliable radio communications are required for, but are not limited to: safety-of-life, security of federal building complexes, federal lands, military bases and other installations; protection of the President, First Family, Vice President & Family, Former Presidents, senior federal officials, visiting foreign heads of states; counterintelligence; investigations involving organized crimes, drug interdiction, fugitives, hostage situations, terrorism, smuggling, gun and explosives, counterfeiting, fraud, forgery, tax evasions; protection of the money supply; prisoner transport and operations of the federal prison system; customs; postal operations and immigration and naturalization.

Current federal law enforcement land mobile radio systems were designed and installed based on specific missions of the various federal entities, the number of radio frequencies allocated and the availability of funding and support personnel. Over time, these systems were gradually expanded as mission requirements increased. These systems provide radio coverage in urban, suburban and rural areas, for both mobile and portable use, and must operate in a wide variety of terrain conditions.

Federal radio systems are often designed to provide coverage to a field or district office whose law enforcement jurisdictions might include more than one metropolitan area and which may also cross state boundaries. The number of federal users in any particular field or district office varies with mission requirements. Field and district offices are frequently complemented with additional personnel to support special operations, such as organized crime task forces, drug interdiction case, protective operations, etc. In many cases, the fixed land mobile radio system is augmented with transportable equipment to provide the required coverage.

Spectral requirements are imposed to support the U.S. Coast Guard mission to provide maritime law enforcement, including drug and illegal immigrant interdiction, in ocean areas, coastal areas and inland navigable waterways. These duties are accomplished through a complex organization of people, ships, aircraft, boats and shore stations, each with unique and challenging communications needs.

Federal law enforcement will require spectrum for technologies that support voice and data communications, paging, video and imaging, electronic agents, sensors, surveillance systems, position location, parole monitoring, covert communications, multi-media applications; and a comprehensive infrastructure which may consist of wireline, microwave, satellite, and HF/VHF/UHF frequencies.

Interoperability with other public safety/public service agencies at all levels of government is a paramount concern. Other issues of interest include, but are not limited to, migration to digital systems, narrowband and wideband technologies, alternative infrastructure considerations and the use of shared systems.

5.2.1 Voice Requirements

Federal law enforcement will continue to depend on voice as the primary method of tactical communication. Voice is the best communication method in a rolling surveillance, quickly developing operations, crisis situations, close-in tactical operations, and in situations where split-second command and control decisions must be made and acted on. Federal personnel must have reliable and secure communications in either peer-to-peer, wide-area, or dispatch-based environments. Other requirements are: air-to-ground, air-to-air, special operations, surveillance (covert) and for national and international travel.

5.2.2 Data Requirements

The use of mobile data technology is becoming more and more important in law enforcement operations. The potential speed and efficiencies available with this technology provides for quicker identification of suspects and dangerous situations which improves agent or officer safety as well as causing faster responses to protect life and property.

Federal agencies envision greater use of commercial off-the-shelf lap-top or notebook computers in lieu of specifically designed mobile data terminals (MDT). This approach is cost effective since it provides the greatest flexibility in meeting ever changing mission requirements.

Border sensors/monitors, electronic agents, parolee monitoring and other remote sensing technologies will continue to evolve and will require wireless communication paths.

Currently, wireless data use within the Federal Law enforcement agencies is minimal. In general, the data requirements are limited to such uses as mobile data terminal applications, geographic position and automatic location data, emergency signals, transmission of reports, electronic messaging, home incarceration monitoring, and perimeter and vehicle alarms. Remotely controlled radio devices are routinely used for turning off and on surveillance microphones, effecting kill switches in vehicles, arming and disarming alarm and monitoring systems, and aiming video cameras. This control can be a one-time data burst or can be a continuous data stream.

Expansion of wireless data systems offers many technological assets to law enforcement. One of the most significant advantages is access to data repositories containing critical law enforcement information such as image identification, fugitive information, stolen articles, and criminal histories. Data repository systems such as the National Crime Information Center (NCIC) 2000 system and the Integrated Automated Fingerprint Identification System (IAFIS) are preparing to provide mission critical data to law enforcement more effectively and efficiently. These systems, in conjunction with the National Performance Review (NPR)/ IT04 initiative (establishment of a national law enforcement/ Public safety wireless network) are preparing for wireless data transfer and will spur the growth of wireless data communications for law enforcement.

Future information technology requirements for Federal law enforcement will most certainly include wireless data and voice systems utilizing encryption. In order to maximize the effectiveness of agents in the field, a mobile office environment utilizing wireless data communications must be developed. This mobile office would provide instantaneous voice, data, and video access to other agents/law enforcement personnel, various law enforcement data repositories, and commercial networks. At some point, law enforcement may incorporate these mobile offices into a paperless environment inclusive of multimedia transfer.

5.2.3 Video Requirements

Generally, video requirements within Federal law enforcement fall within these categories: incident video, aerial surveillance video, robotics video, surveillance and monitoring, officer safety and operational video transmission, and still photographs.

5.3 INFORMATION SYSTEM SECURITY

Preservation of the confidentiality of the information passed and the integrity of a communications system is of paramount importance to the overall federal mission. Threats may exist anywhere along a communications path. Federal agencies are extremely concerned with threats to the wireless component of the communications network, both the active threats: masquerading, information modification, denial of service, sabotage and the passive threats: monitoring/eavesdropping, traffic flow analysis.

In light of this, federal agencies must have the technical means at their disposal to counter both today's threat and that of the future. Such techniques are covered under the information systems security umbrella.

Federal agencies have a requirement for cryptographically protected wireless communications systems.

Suitable cryptographic algorithms or techniques are available to provide the necessary levels of privacy/security commensurate with the federal mission. Federal government cryptographic processes are categorized by "type" with Type-I being the highest and Type-IV the lowest. Information that is classified pursuant to federal statue or executive order must be protected by use of an National Security Agency (NSA) approved Type-I cryptographic algorithm and implementation. Type-II algorithms are used by federal agencies for the protection of defense related sensitive-but-unclassified information. Type-III algorithms are used by federal agencies for the protection of all other sensitive-but-unclassified information. The National Institute for Standards and Technology provide for the endorsement of Type III algorithms and their implementation.

In addition, where cryptographic protection is employed, federal agencies require user friendly electronic key variable dissemination and management. Terms such as Over-The-Air-Rekey (OTAR) are often used to describe this process, often in conjunction with multi-key, which refers to the use of multiple cryptographic keys to facilitate interoperability.

Extremely sensitive information may require the application of multi-dimensional techniques providing for low probability of detection or low probability of interception, and are often referred to as covert communications. The accommodation of covert communications poses unique spectrum requirements.

Lastly, there must be adequate trust in the operating systems and software used in the network components, as well as the continuous use of access control and authentications services to prevent authorized users from being denied the use of their mission critical communications services or networks.

5.4 NATURAL RESOURCES, PUBLIC SERVICE, AND FIRE EMERGENCY SERVICES

The Federal Government manages its natural resource programs using radio communications to accomplish Congressionally-mandated missions. Congressionally-mandated services include the mission of the U.S. Postal Service. Fixed stations, mobiles, hand-held portables, and transportable repeaters and base stations make up these radio systems. These operations are spread throughout the United States and its Possessions, in suburban, urban and rural, sometimes remote and almost inaccessible areas. Some systems encompass only a few buildings in a city or a small wildlife refuge, while others encompass large geographic areas, such as the national forests, Indian reservations, and national parks; multiple counties or states such as the Tennessee Valley Authority; or are nationwide in nature. These systems provide for the safety of the public and government personnel which includes over 300,000 postal vehicles and the security of 180 billion pieces of mail per year, monitoring and distribution of water, management of timber growth and harvest, protection, operation, and management of our national parks, national forests, range and grass lands, wildlife refuges, protection of Native Americans and protection and management of their lands; forestry and range management; and assessment of mineral deposits. In addition, wildlife monitoring and tracking to protect endangered and threatened species and to control animal damage are performed with transmitters as small as dimes or as large as softballs. The gathering of wildlife data is crucial to track and catalogue the motions of specific species under study by multiple parties. The emphasis is on the identification of present and future migratory patterns which will influence the environmental habitats and future survival of these species. This telemetry is solely dependent on wireless technology.

Natural emergency situations such as fires, hurricanes, earthquakes, and volcanic eruptions place great demands on existing communications systems and sometimes require a tenfold expansion of communications facilities in a matter of hours. The U.S. Departments of Agriculture and Interior are responsible for maintaining a large inventory of radio systems available for rapid deployment in support of fighting wildfires or natural disasters. The agencies and bureaus of both departments maintain installed communications systems supporting the day to day administrative and tactical operations on almost 500 million acres of public land. These systems also support numerous search and rescue situations. In the event of fire or disaster, the installed systems are capable of being expanded through communications resources available from the National Interagency Fire Center in Boise, ID. This unique sharedagency facility maintains a cache of approximately 7000 radios that are preboxed into fully operational groupings called "systems" or "kits"; each containing one or more repeater stations and a

number of portables. The majority of these radios operate in the VHF, 162174 MHz band with approximately 1500 operating in the UHF, 406520 MHz band. Additional equipment available from the Center includes 10 transportable INMARSAT satellite ground stations and several transportable microwave stations. Since aircraft can taxi directly up to the Center's front door for loading, this equipment can easily be shipped back and forth between most locations in the United States, Canada, and Mexico and be distributed to local authorities, allowing for cooperative, interoperable communications between Federal, state, and local agencies when necessary.

Federal Fire-fighting services, when their mission is to serve a specific base or installation, in general, function in the same manner as State and local government fire fighting services. Where Federal fire management missions diverge is in the responsibility for fire protection and fire fighting over wide-ranging federal lands such as National Parks and National Forests. The National Interagency Fire Center is responsible for management of this function within the Federal Government. It includes the Bureau of Land Management, National Park Service, Bureau of Indian Affairs, U.S. Fish and Wildlife Service, U.S. Forest Service, the National Weather Service and Interior s Office of Aircraft Services. These bureaus and agencies form an interagency partnership aimed at providing efficiency and economy in the field of fire management to include presuppression, suppression and fire use.

The Federal Maritime Environmental protection mission, performed by the U.S. Coast Guard, serves to minimize damage from pollutants released into the ocean, inland waterways, and coastal zones. In addition, they help to develop national and international pollution response plans and operate the National Strike Force. These operations frequently involve close coordination by Federal, State, and local agencies in addition to private and commercial organizations.

5.4.1 Voice Requirements

In general, voice requirements for Natural Resources management include coverage from portable to portable unit, through a system, radio to radio. Personnel must be able to speak with each other via a portable radio if within line of sight. Likewise personnel must be able to communicate from distant locations where geographic responsibility for a natural resource crosses all political boundaries.

5.4.2 Data Requirements

The data requirements of Federal Natural Resources and Fire Emergency Services is not unique to the Federal agencies. State and local public safety agencies have similar requirements. In general, the data collected, analyzed, and disseminated in these services originates and terminates among Federal, State, and local agencies alike.

Wireless data transmission is mission critical to the Postal Service. In order to provide continued low cost mail service to over 95 million addresses, spectrum must be available.

The gathering of Hydrological data is crucial to assure the latest weather patterns, snow and precipitation levels, temperature and water quality are monitored in order to minimize a natural disaster due to these conditions. The emphasis is on the collection of data from remote sensors and prediction of flooding conditions based on that data. The Federal Hydrologic program involves a large number of Federal agencies as well as State and local agencies. The network, data, and frequency assets are shared among these agencies.

The gathering of seismic data is crucial to assure that earth movements and motions are cataloged and patterns detected to reduce potential earthquake damage, and potential loss of life and property.

For wildlife telemetry,.the basic need for data is immediate, clear transfer of information concerning the mobility of wildlife.

5.4.3 Video Requirements

Requirements encompass a wide variety of scenarios ranging from provision of fullmotion realtime

video from onsite personnel or robotic sensors to remote command center, to slowscan images for damage assessment. These video data should be accessible by a number of users under strict, needtoknow management procedures. Often a video image of current conditions is necessary to make critical decisions, like the release of water from a reservoir, in the management of natural resources.

Hydrologic management requires the ability to transmit still photographs on demand to various locations to facilitate decisions concerning the adjustment of water releases or the evacuation of population downstream from a flood stage river.

5.5 EMERGENCY MANAGEMENT AND DISASTER SERVICES

The Federal Government provides an array of emergency and disaster response communications capabilities to protect the public and resources from natural and technological hazards. This involves a wide range of missions including prevention, mitigation, preparedness, response, and recovery. These services involve virtually every department and agency of the government. Where safety of life and property is at risk, communications systems that can operate reliably when normal systems are disrupted are essential. A significant number of the Federal Government emergency and disaster response communications systems interface (but are not necessarily interoperable) with State and local governments as well as with national volunteer organizations such as the Red Cross, amateur radio operators, and similar groups.

Many specialized emergency requirements have unique spectrum-dependent needs that must also be satisfied by the nationwide dedication of radio spectrum for that purpose. As an example, Federal, State, and local government search and rescue teams deploying to the site of a national emergency or disaster need reliable communications to locate victims in collapsed buildings, administer medical and lifesaving treatment and relocate them to safety or medical facilities.

The U.S. Coast Guard, in cooperation with other Federal, State, and local public safety agencies, monitors distress and safety radio channels 24 hours/day, and serves as maritime Search and Rescue (SAR) coordinator within the National SAR Plan. The Cospas-Sarsat Search and Rescue satellite system is an example of dedicated emergency response communications system. This multi-national safety-of-life system uses earth orbiting satellites and ground stations to locate emergency distress beacons. These beacons signal that a life-threatening maritime, aviation, or land-based emergency has occurred. Current spectral requirements include 406-406.1 MHz, 121.5 MHz, 243 MHz, and 1544-1545 MHz. Future expansion of the system may add the use of geostationary satellites and beacons using GPS locations.

Providing the communications needed during major natural and technological emergencies requires a significant quantity of readily deployable land mobile radio communications assets. Major disasters have required the deployment of thousands of radios. These have traditionally been Federal Government owned land mobile radios (e.g. the fire cache discussed above) used to effectively coordinate and provide emergency management during the readiness, response, and recovery phases of major disasters.

5.5.1 Voice Requirements

Emergency Management and Disaster Services within the Federal Government have a need for a large number of interoperable radio assets able to be deployed anywhere in the nation on a moment s notice. These requirements are generally the same as with State and local government and disaster relief organizations. Primarily, they include numbers of radio and frequency assets that far and away exceed normal operating requirements. Lack of interoperability, in the technical and spectrum senses, represents the greatest impediment to the effective solution of these needs.

5.5.2 Data Requirements

In general the data requirements of Federal emergency management and disaster services are similar to those of their state and local counterparts. Often the data collected, analyzed and disseminated in these services originates and terminates among Federal, state and local agencies alike. A current example of

Federal emergency service data usage is in the broadcast and response to Cospas-Sarsat distress alerts.

5.5.3 Video Requirements

Like the data requirements, Federal emergency management and disaster service video requirements are similar to those of their state and local counterparts. As an example, on-scene video is often utilized to assist in developing appropriate level of response.

5.6 TRANSPORTATION

Federal activities in aviation, maritime, highways, and railroads have a tremendous investment in both fixed and mobile operations. Aviation-sector land mobile applications include maintenance, safety, and inspection using portable and mobile radios, and repeater and base station facilities; remote maintenance monitoring equipment; airport runway light control systems and wind shear alert systems. These systems are installed in airports and airway facilities for management and coordination activities. The systems use both voice and data to: automate equipment monitoring; perform safety-of-life, anti-terrorist, and air security functions; integrate air traffic control communications within the centers and control towers; and conduct various airport and airfield communications.

Federal surface transportation operations provide a variety of management and oversight support to coordinate activities at various highway and rail sites. The Intermodal Surface Transportation Efficiency Act (ISTEA) was passed by Congress and approved by the President in December 1991. It enabled the establishment of the Intelligent Transportation Systems (ITS) program. Several goals of the ISTEA are addressed in the ITS program, including: (1) the enhancement of the capacity, efficiency, and safety of the highway system, serving as an alternative to additional physical capacity; (2) the enhancement of efforts to attain air quality goals established by the clean air act; and (3) the reduction of societal, economic, and environmental costs associated with traffic congestion. The relationship between ITS and public safety encompasses several aspects concerning not only the safety of the traveler, but the array of new technologies and services that will be available to both personally owned vehicles as well as vehicles owned and operated by emergency service providers and traditional public safety agencies.

Public safety goals of the ISTEA legislation being addressed by ITS are reducing the frequency of accidents, reducing the severity of accidents, reducing congestion due to incidents and enhancing traveler security. Technology being deployed by ITS will enable these goals to be met by performing the following safety-related functions described in the ITS National Program Plan: improving on-board system monitoring, reducing the number of impaired drivers, enhancing driver performance, enhancing vehicle control capability, improving traffic safety law enforcement, smoothing traffic flows, improving emergency and roadway services responsiveness, improving passenger protection, improving response to hazardous materials (HAZMAT) incidents, improving incident management, improving incident information to drivers, improving the availability of communications devices, reducing vehicle theft, and increased monitoring of transportation facilities.

Maritime safety and waterway management agencies within the Federal Government provide for the safe operation of the Nation s navigable water resources. It requires coordination of many diverse, yet interrelated disciplines. From inspection of user vessels and offshore facilities, to provision of icebreaking capabilities to keep shipping routes open year-round, to ensuring port security, many tasks must be performed to ensure seamless utilization of coastal and inland waterways. In addition, safe passage is promoted through waterway management involving the interrelationship between vessels, waterway authorities, and facilities including docks, bridges, and piers. Finally, a key link in ensuring maritime safety results from continuous monitoring of maritime radio emergency channels, and the broadcast of maritime safety information.

5.6.1 Voice Requirements

In general, voice requirements for Federal Transportation services are similar to other Federal agencies. Immediate or near-immediate voice communications is an absolute necessity, especially when dealing with safety-of-life/property response.

Voice communications for maritime safety and waterway management must provide connectivity for command, control, and communications of operational U.S. Coast Guard forces; ensure connectivity, compatibility and interoperability with the maritime industry, the boating public, and other Federal, state and local agencies. Supported services must include: (1) Damage and degraded service/outage reports to/from mariners, (2) notification of marine casualties, (3) dissemination of Notice to Mariners, and (4) reports of pollution incidents and coordination of responding assets.

5.6.2 Data Requirements

Basic data requirements for Maritime Safety and Waterway management include clear, immediate transfer of information in support of both routine and emergency operations. Examples of required services include: (1) short range aids to navigation, (2) acquisition of vessel position, identification, and sailing intentions, and (3) data dissemination with respect to ice conditions and/or port status.

ITS by its very nature, is totally dependent on mobile communications in order to provide most of the user services. ITS frequencies must fit several criteria, among which are good propagation characteristics for the function being performed, adequate bandwidth, freedom from harmful interference, availability of low-cost components, and minimal regulatory restrictions.

There are three basic ways to provide the connectivity that is needed for ITS: (1) through the use of existing communications facilities (e.g. cellular radio, enhanced specialized mobile radio (ESMR), existing dispatch systems); (2) through new services within current spectrum allocations (e.g. high-speed data subcarriers on broadcast FM radio); or, (3) through dedicated facilities with new spectrum, which includes cases where current allocations are inadequate and where new spectrum is required to meet growth demands (e.g. electronic toll and traffic management (ETTM)).

To the maximum possible extent, the Federal Highway Administration (FHWA) has emphasized the appropriate use of the first two alternatives. However, dedicated spectrum may be needed to support critical public safety and warning services where reliability, accessibility and liability are primary issues.

5.6.3 Video Requirements

Video requirements for Transportation management may include real-time situation updates from on-scene units to command centers. Multiple agencies may need to have the capability of monitoring another agency s video transmissions, however this capability must be controlled through a need to know or incident management process.

6.0 CURRENT SHORTFALLS

The mission of the Subcommittee included identifying operational requirements that currently are unmet or suffer from reliability, quality or coverage deficiencies. Shortfalls of this nature were identified by virtually every working group, but in general they can be categorized as indicated in the following discussion.

Foreign Frequency Interference. Public safety entities operating along United States borders with Mexico are experiencing interference from communications devices and services located outside the United States. For example, business communications from Mexico are occurring on VHF and UHF public safety frequencies. Coordination with Mexico or other decisive action is necessary to ensure that whatever frequencies are allocated for public safety use in the United States remain free from foreign frequency interference.

Insufficient Paths or Channels. A general observation of virtually all participants in the Subcommittee's work was that the existing allocation scheme does not provide sufficient paths or channels to support existing operations, let alone the future needs identified by the various working groups. Some public safety entities already have been forced to lease voice communications support due to channel shortages. Shortages exist in some parts of the county in microwave channels for infrastructure support. Existing

allocations do not and will not support implementation of mobile data or NCIC 2000 terminal needs, or transmission of video.

The rapid growth of the field of corrections, for example, has placed and will continue to place unprecedented demands on the need for communications paths or channels. Over the last fifteen years, as a result of the public's demand for aggressive "gettoughoncrime" policies, the adult population in prisons and jails has tripled to approximately 1.5 million persons. Similarly, the number of adults on active probation or parole since 1980 has grown at an average annual rate of 7.6% to approximately 3.6 million persons. As of January 1, 1995 there were 1449 prison in operation as well as 108 new facilities under construction and 167 existing facilities being expanded. Consequently, these increases in the number of facilities and staff necessary to manage this growing segment of public safety will drive the proportional need for additional paths or channels.

Although these shortfalls are universally understood and a major portion of the rationale for formation of the Advisory Committee, the Subcommittee deemed it appropriate to highlight the urgency created by the spectrum shortfalls that already exist.

Coverage Inside Buildings. Present standards in the 800 MHZ spectrum limit signal strength to 40 dBu at service area boundaries. This strength frequently is not sufficient to support building penetration near service area boundaries. Standards for channel use in adjacent service areas must allow sufficient signal strength to achieve building penetration throughout a user entity's entire service area.

MultiPath Interference. Voice communication problems created by multipath interference in some frequencies must be resolved to provide clear voice communications in areas affected by multipath interference.

7.0 INTEROPERABILITY ISSUES

Interagency communications between federal, state, county, township and local police, fire, and EMS units is necessary. Coordination at natural and manmade disasters requires close communication for deployment of scarce resources during incident management by the police, fire and EMS units responding to the event.

The ability to communicate among and between the various public safety units must also be broken out by geographic area yet respecting the ability to "lookback" or monitor the chain of command of the several organizations. In other words, at the site of a wide area incident various police and fire units responding should be able to monitor selected channels or talk groups within their organizational structure, but also have the ability to speak across organizational lines (police to fire, fire to EMS, etc.) to coordinate activities at a given geographic location up to several miles wide.

Interoperability must exist across organizational groups by rank or responsibility. The officer in charge of comparable responsibility from each of the respective jurisdictions should have the ability to speak directly with each other in a secure or uninterrupted channel or talk group over the portable radio to deploy the necessary resources where they are most needed.

Interoperability is not just an issue for response to unique or large scale public safety incidents. Interoperability is requisite on a routine basis as a preventive measure. For example, sharing information in the form of voice and data between correctional and law enforcement agencies can lead to the quick identification of criminal behavior patterns and expedited apprehension. Crime prevention requires more resources, not just more laws.

ANNEXES

A OPERATIONAL REQUIREMENTS FOR COMMUNICATIONS QUALITY

B - OPERATIONAL REQUIREMENTS INPUTS TO QUANTITY MODELING

C - ADDITIONAL PUBLIC SERVICE OPERATIONAL REQUIREMENTS

ANNEX C - ADDITIONAL PUBLIC SERVICE OPERATIONAL REQUIREMENTS

1.0 Voice Requirements.

1.1 Dispatcher to Crews. This is a typical communications path between dispatchers and field personnel. The call types are typically business oriented with emphasis on operating the business in a safe and efficient manner.

1.2 Crew to Crew. This function relates to the typical communications between field users. These communications are used for the coordination of daily activities to maximize the safety and efficiency of operations.

1.3 Emergency Call. This function is typically initiated from a field user to a dispatcher. As the name implies, the call type is that of an emergency where loss of life or property is imminent or has already taken place.

1.4 "Talk Around". In many operations between field users, routing a call through the network or a repeater is not feasible for reasons such as access delay or being out of range of the system. A talk around mode is necessary so that the field users can communicate with each other, within the range of their mobiles and portables, without the assistance of a network or repeater.

1.5 Interconnect. In nearly all field activities, users have a need to communicate with people by way of land line telephones. Telephone interconnect is a necessary option for many of the present day radio systems.

2.0 Data Requirements.

2.1 End of Train Control. This is a system which provides a data communications link between the end of the train and the train crew. With this link, the engineer of the train can determine if the end of the train is in motion, what the brake line pressure is and whether the end of train flashing marker is illuminated. The engineer can also apply the brakes from the end of the train by remotely releasing the brake pipe pressure. All functions associated with this device relate to safer handling of the train.

2.2 Positive Train Control. This is a data system which utilizes a computer on board the locomotive to minimize collisions between trains. The locomotive computer obtains movement authorities from a host computer and calculates when it needs to stop the train based on the speed and weight of the train. If the limits of authority are going to be violated, the computer will stop the train automatically.

2.3 Track Warrants. Track warrants are the movement authorities which are used by the train engineer. Track warrants are typically read to the engineer over the radio system by the dispatcher. There are plans in place to provide a data link between the dispatcher and the train engineer to reduce errors in copying the track warrant.

2.4 Crossing Safety. Crossing accidents are of great concern to the railroad industry. Systems are being investigated which will provide a notification to public safety vehicles and school busses that a train is approaching a specific crossing which may affect them. This will provide added warning of approaching trains.

In addition to the warning systems, data links are being investigated which will be used to report any malfunctions with the railroad crossing. Defects such as inoperative or broken crossing arms, vandalism, as well as power failures can be reported to maintenance personnel.

2.5 Cab Signals. Cab signals provide a visual warning to the train crew as to the status of the track immediately ahead of them. As an example, if the track is occupied, the signals to the train crew will show red. If the track is clear, the signals will show green. This form of alerting the crew is very helpful

in train control and collision avoidance.

2.6 Train Line. The current form of braking for trains is through a pressurized brake line. If the air pressure is reduced, the brakes of the cars as well as the locomotives are applied. Often the air pressure does not respond as quickly or as fully as needed by the train engineer, creating a problem with train handling.

A train line is being developed which will provide a communications path thorough the train. One of the functions of the train line will be to provide electronic breaking information to each car, eliminating the need for the air line.

2.7 Consist Telemetry. An extension of the train line function listed above is a communications system which handles information for all items being transported. Typical information includes the condition of the cargo in terms of over temperature or rough riding which would be helpful when transporting hazardous materials. Other uses would be to provide additional alarming to the train crew for purposes of theft and vandalism control.

2.8 Facilities and System Protection Telemetry. The power utilities rely on communication links to assist in monitoring and control of power distribution systems. Very large and fast acting circuit breakers obtain information about short circuits and disconnect the power source in order to minimize risk of life and damage to property. These communication links are also utilized in the substations which are used to reduce the voltage of the transmission systems for distribution to households.

Pipe line companies transport a variety of materials which include water, oil , gas, and steam. Electronic monitoring and control systems are designed to assist the operators of these transport networks. If a malfunction occurs, the materials can be rerouted or their flow can be inhibited to minimize the impact to life, property, and the environment.

2.9 Load Shed Telemetry. On a smaller scale from system protection as described above, load shed telemetry is used to control the amount of power used by consumers. A data communication system is used to remotely control air conditioners and electric water heaters in an attempt to minimize overloading of the transmission and distribution systems.

2.10 Defect Detector Communication Link. Defect detector communication is typically one way and is composed of a low power transmitter located at the detector sites. If a defect is detected, a synthesized voice radio transmission is sent. This will alert the crew of the train in the area of the detector before injury and/or damage occurs.

The following is a list of typical defect

detectors:

1. Hot box/journal.

2. Dragging equipment.

3. High and wide equipment.

4. Rock slide/mud slide.

5. Flood.

2.11 Security System Monitoring. Property and equipment need to be monitored via security systems. Most of the applications require some form of wireless communications to establish the link.

2.12 Location Systems. For train control, location systems such as GPS are needed to obtain the location of the train in relation to limits of movement authority as well as other trains. Unfortunately, standard

GPS does not have the required accuracy which can be accomplished by Differential Global Positioning Systems (DGPS). One of the requirements for the DGPS system is that the users must have a secondary data link which is independent of the satellite link.

2.13 Inventory Access. Both railroad and utility industries have situations where access to a store department record would facilitate derailment clean up or storm restoration respectively. To accomplish this, a data link between the field user and a host computer is necessary in order to determine and acquire needed materials.

3.0 Video Requirements.

Video Surveillance. As an extension of the security system monitoring item above, video surveillance provides much more information in specific situations than typical alarms can provide. In may cases, the video surveillance would be most effective if it was available through a wireless means.

4.0 Special Agents

Another application for communications in Public Services are those communications which occur between railroad police, also known as Special Agents, and local, state, as well as federal agents. The Special Agents have arrest authority if a crime occurs on the railroad right of way. They are often the first responders when dealing with murder, rape, robbery, drug enforcement, and vandalism just to name a few. These incidents require communications with other law enforcement agencies in order to coordinate operations.

Many of the railroads have a K9 unit. The railroad police dogs are trained to assist the Special Agents in the same ways that Public Safety Police dogs are utilized. As an example, they are used to locate illegal drugs on railroad property. Once the suspected illegal materials are found, the Special Agents work with the local and federal law enforcement agencies for further investigation and handling.

During derailments, the Special agents work with a variety of Public Safety entities to coordinate activities with the railroads in an effort to contain the disaster as quickly as possible. Most of the communications are voice, however, there is a significant need for data communications for the purposes of having access to the same information which is shared between the Police, Fire, and Rescue entities.

Back to the Operational Requirements Page
Return to PSWAC Home Page